RAILROAD GAZETTE

FRIDAY, OCTOBER 12, 1900.

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The Stresses in Arch Bar Frames—A Correction.

In this article some errors, mainly typographical, appeared last week. On page 652, column two, tenth line from bottom, "V_2" should read V_1. Same page, column three, finding of vertical axis from details of Fig. 4 should read as follows: $I = 35.4$ and $S = \frac{I}{y} = \frac{35.4}{2.5} = 14.2$; therefore $f_m = \frac{230{,}000}{14.2} = 16{,}200$ lbs., etc. Later in the same paragraph, "f = 25,700 lbs," etc., should read f = 25,270 lbs. Page 653, Figs. 3 and 5, horizontal force at center of truck, 14,055 lbs. for one axle, as appearing on the original drawings, should be doubled, making horizontal force applied at center of truck 28,110 lbs. Column three, same page, near top, "$\frac{1}{r} = 3$," should read $\frac{1}{r} = 3$, etc.

The compositor closed his field day by stating, in a little type juggling further down the column, that "cussing is a most complex and difficult matter to handle." We disagree wholly with that statement; but the transposition of the line is at once apparent.

Contributions

Narrow Fire-Boxes and Back Pressure.

Pittsburgh, Oct. 5, 1900.

To the Editor of the Railroad Gazette.

The October issue of *Locomotive Engineering* criticises, with some sarcasm and more figures, my expression, in a recent issue of the *Railroad Gazette* (made, perhaps, with unbecoming levity and lack of reverence for ancient practice) with reference to a narrow fire-box engine "spending a large part of its power in pushing the steam out of the cylinders." An early reply being in order, I ask the favor of your columns for the purpose.

In the first place, *Locomotive Engineering* is in error in holding me to be a persistent advocate of the "so-called Wootten type of boiler," by which is doubtless meant the specific design of wide fire-box boiler which was patented in 1877, by the late J. E. Wootten, and which was new and original with him, so far as anything to the contrary has yet been shown. I have been an advocate of the properly termed (not "so-called") Wootten boiler, but it does not now seem to be the best type of wide fire-box construction, and has not been, for some time past, urged by me. Some form of wide fire-box I maintain to be essential, in a correctly and intelligently designed locomotive boiler, and I have been and am a persistent advocate of the best form of wide fire-box boiler, whatever that may be determined to be.

The novelty of Mr. Wootten's design of boiler is attacked by that journal more directly than in the criticism of my statement, in an article on the life and work of the late Mr. Charles Graham, which appears on pages 450 and 451 of the same issue, and which may be properly here replied to, in view of the bearing of the article on the criticism referred to. On page 451 the following statements are made:

"Zerah Colburn had designed an engine with a wide fire-box extending over the frames, with a view of providing the large grate area necessary for burning anthracite coal. . . .

"Towards the end of the seventies Mr. Wootten, of the Philadelphia & Reading, put a combustion chamber in a Colburn fire-box and secured a patent on the combination. A company was formed to push this patent, and it was exploited under the name of the 'Wootten fire-box.' This was done so effectually that to-day all fire-boxes extending over the frames are spoken of as Wootten, although most of them are merely Colburn fire-boxes with Graham's improvements."

The Colburn engine referred to, I assume to be that which is described and illustrated in Colburn's "Locomotive Engineering," 1871, pages 83 and 84, Figs. 96 and 97, as this and a few others of similar construction are the only "wide fire-box" engines designed by Colburn of which I have been able to find any record. By reference to the description and cuts above mentioned, it will be seen that the resemblance between the Colburn and Wootten boilers begins and ends with the fact that both have wide fire-boxes, and this feature alone was never attempted to be claimed by or in behalf of Mr. Wootten. The Colburn fire-box, instead of "extending over the frames," was, as a matter of fact, overhung and located entirely behind the frames and the rear drivers, a construction which would obviously be impracticable in a road engine and undesirable even in a yard engine. The Wootten boiler, on the other hand, was designed to provide a wide fire-box "extending over the frames," without raising the waist of the boiler to the undue and inadmissible extent which would be unavoidable under the Colburn design. This was effected by the combination of a wide fire-box "extending over the frames" and the rear drivers, a combustion chamber in the waist of the boiler, and an interposed bridge wall. A vivid imagination is required to discover this combination in the Colburn design, or in any other which preceded the Wootten boiler, and when the latter was "exploited under the name of the 'Wootten fire-box,'" the exploitation was fully warranted, both legally and morally.

The figures given on page 434 of October *Locomotive Engineering* are neither clear nor convincing in support of the claim, as to which they are evidently presented, viz.: that narrow fire-box engines are not handicapped by their contracted exhaust nozzles. The comparison does not appear to have been made under similar conditions, as the wide fire-box engines referred to are apparently anthracite coal burners, while the narrow ones are undoubtedly burning bituminous coal. It is too plain for discussion that larger nozzles may be used with free burning bituminous fuel than with anthracite, and equally obvious, as it seems to me, that a grate of 26 sq. ft. (one of the instances given) would not make steam with anthracite coal, for any effective service, no matter how small a nozzle was used.

Again, the diameters of nozzles given are doubtless taken from published dimensions of the engines referred to, and it is well known that these, in many cases, do not agree with the diameters which it is found necessary to adopt after the engines are put in service. The fact, if it be a fact, that some anthracite coal burning wide fire-box engines are running with smaller nozzles than are necessary, while some narrow fire-box engines may be gotten over the road, with bituminous coal and hard firing, using larger nozzles, proves nothing. Without knowing the dimensions of the respective nozzles, it does not take a very vivid imagination to observe the difference between the ordinary soft and mushy exhaust of a wide fire-box engine and the sharp bark of one with a narrow fire-box, and to conclude, on general principles, that the back pressure is greater in the latter case than in the former.

J. Snowden Bell.

The Cause of Foaming in Locomotive Boilers.

By C. Herschel Koyl.

I have reasons for the belief that, under ordinary conditions of service, boiler foaming takes place only in the presence of particles of matter suspended in the water in the boiler. This belief is at variance with the usual opinions on the subject, and I therefore present some of my observations and the conclusions I have drawn therefrom.

Not all the causes of foaming are known with certainty, I believe, to any one. The general* belief appears to be that foaming is produced by the presence of the salts of sodium—alkali salts—commonly called alkaline salts though some of them are not alkaline at all, sodium chloride for instance being common salt and having no alkaline reaction, sodium sulphate being just as neutral as sodium chloride. But I have not been able to find evidence of water caused to foam by the alkali salts except in the presence of matter in suspension.

In the laboratory I have many times fed into boiling distilled water quantities of chemically pure sodium carbonate, up to several hundred grains per gallon, without producing any foaming effect. But if there is fed into boiling distilled water a fine insoluble powder such as calcium carbonate or magnesia alba the water will soon be foaming as vigorously as any one could wish.

If hard water is used in a boiler of any kind until a scale has been formed and the boiler then is fed with rain water or any other soft water, a disintegrating action upon the scale begins immediately, the water is filled with floating particles of loosened scale and a violent foaming ensues.

It is frequently the case in railroad service that a locomotive is supplied from a tank containing hard water which of course begins to form scale in the boiler, and that later the locomotive is supplied from another tank containing alkaline water. In this case the action of the alkali is exactly the same as the action of the rain water, or of soda ash when used as a boiler compound, and its effect is not only to precipitate scale matter from the hard water but also to disintegrate the scale attached to the boiler and, from these two sources, to fill the water with floating particles which soon start the boiler foaming.

It has been the common practice to attribute the foaming of the boiler to the alkaline water because it was fed in just before the foaming began, while according to my opinion it was only the loosened scale matter which produced the foaming, and there would have been no foaming had there been no scale. It is perfectly natural, in the absence of other information, to ascribe the foaming of a boiler to the last water which was put in; but in the same manner it might be asserted that two taps of the bell move a street car because the street car moves immediately after the two taps are heard.

Three physical conditions are recognized in boiling liquids in the laboratory and doubtless may exist in boilers of any size and pressure: (1) "Bumping," when the steam rises in great bubbles and tears such holes through the liquid that vigorous thumping upon the bottom of the vessel is produced by the liquid falling back to its place. (2) "Quiet boiling" when the steam appears to enter the water freely and to rise through it without difficulty. (3) "Foaming," when the steam and the liquid appear to be so intimately mixed that they cannot easily be separated, and the liquid is carried up and out with the bubbles of steam.

In making ammonia determinations by the Kjeldahl method there is frequently much difficulty in preventing on the one hand bumping and on the other hand foaming of the alkaline liquid during distillation. If a caustic soda solution, strong and clear, is used to liberate the ammonia there is great bumping, frequently of sufficient violence to shatter the flask. If a caustic soda solution, strong and turbid (from various suspended impurities present in the commercial article), is used there is furious foaming. But if a caustic soda solution, strong and clear, is used and zinc dust is added to the proper amount (very little suffices) a point is reached at which the bumping ceases and foaming does not commence; while if more zinc dust is added foaming follows. This illustration appears to me to be free from complications and to leave open no other conclusion than that bumping is obviated, and the liquid caused to boil quietly, by the introduction of a small amount of insoluble powder; and that, given a quiet-boiling liquid, foaming is produced by the addition of a little more insoluble powder.

Fortunately there are analogies for illustration which may explain why a few particles of foreign matter may prevent boiling water from bumping and more particles may cause it to foam. It is well known that perfectly clean water in a perfectly clean vessel may be cooled below 32° F. (0° C) without freezing, or that it may be heated above 212° F. (100° C) without boiling; but that dropping into it a small piece of solid matter of any kind will cause it in the one case to begin to solidify along the course of the particle, and in the other case to burst into steam along the course of the particle. These are the phenomena of super-cooling and super-heating, and are generally ascribed to the viscosity or cohesion or internal friction of the water which prevents on the one hand freezing or on the other hand the formation of steam bubbles, until in the one case the crystallizing force is in excess or in the other case the internal vapor tension exceeds considerably the external pressure or vapor tension.

If now perfectly clean water in a perfectly clean boiler tends to remain at rest and therefore to become superheated at the heating surfaces, and therefore to liberate its steam only at intervals and therefore to "bump," the addition of some foreign matter such as is in all ordinary water will release the steam more frequently, and may be made to do it at such intervals as to result in quiet boiling; while if these particles are increased in number the liberation of steam throughout the water in the vicinity of each particle may produce such an almost infinite number of bubbles that the boiling water becomes a seething mass so filled with bubbles as to occupy the whole space of the boiler and to make it impossible for the bubbles all to break at the surface without throwing up quantities of water to go over mechanically with the steam. This is foaming.

In boilers working at a high temperature there is seldom noticeable bumping, because the water is separated from the heating surface by a thin layer of steam, and this prevents the super-heating of the water which gives rise to the sudden bursts of steam which produce bumping. If however the boiler is covered with scale which separates the water from the hot iron, and a piece of this scale is loosened in any way so that some of the water may strike the iron which is at a much higher temperature than the water, a sudden burst of steam takes place sometimes sufficient to rupture the boiler. If a stream of cold water condenses the film of steam and so reaches a hot boiler sheet, the same sudden burst of steam may take place with the same result of bursting the boiler.

The point to be remembered is that this bumping in any of its forms is due to the super-heating of the water and to the sudden release of large quantities of steam at the heating surface. When the water contains a small number of particles in suspension, each of these particles

* American Railway Master Mechanics' Association; Report of Committee on the Best Method of Preventing Trouble in Boilers from Water Impurities, 1899.

serving to release the steam and therefore the superheating in its immediate vicinity (as is easily seen by observing the phenomenon in glass vessels) the result is quiet boiling. When the water contains a very large number of suspended particles, each serving to release the steam in its immediate vicinity, steam bubbles are formed not merely at the heating surfaces and not merely at a few other places but in every part of the water, with the result of increasing the space occupied by the water to such an extent that the water may be forced out of the steam pipes.

Of course a sudden reduction of pressure outside the boiler might carry over water in any quantity, of course water saturated with air or gas would boil with great disturbance, and of course a lot of soap put into a boiler would produce very sticky wet steam, but by the limitation made in the first paragraph—"under ordinary conditions of service"—I have endeavored to eliminate from the discussion such causes as are not likely to exist in ordinary boiler work, but to include others which do occur, such as heavy hill climbing when for a time the engine is calling for enormous amounts of steam and the water in the boiler must be in ideal condition if such amounts of steam are to rise through it without taking it along.

Of the ordinary cases of boiler foaming: (1) That produced by the use of boiler precipitants I explain as above, and hold that the foaming is produced by the suspended matter in the water and without regard to the amount of alkali salts in the water except in so far as this may be a gage of the amount of matter precipitated. (2) That produced by the use of alkaline feed water I explain in the same way, with the exception noted in a later paragraph. (3) The foaming produced by water from some of the Western rivers which contain mud and organic matter, appears to me to be explicable on this theory and on no other, for many of these waters contain no alkali. (4) The foaming sometimes produced in a locomotive fed by a water-softening machine, may be due to either of three causes: (a) the boiler may have been coated with scale which the soft water disintegrates and loosens; (b) the water furnished by the machine may not have settled well, nor have been filtered, so that it contains matter in suspension when it enters the boiler; or (c) the machine may not have been capable of completing the softening of the water (there are such machines), but if the proper amount of chemicals has been supplied to the water, this softening action—this scale-matter precipitation—is completed within the boiler and of course produces foaming.

It is probable that the presence of alkali salts does, by increasing the surface tension of the water, increase the severity of the foaming which results from the cause above mentioned; but, so far as I know, the production of foaming by the use of, say, salt water—alkali water but not alkaline water—takes place only when the solution is so concentrated as to be filled with particles of solid salt; and the view of the case which holds that foaming is due to alkali alone could be established only by feeding perfectly clean alkali water into an absolutely clean boiler, which, it is needless to say, is difficult to find among boilers which have been in service.

One apparent exception serves only to prove the rule. It is possible to have a clean alkali water, containing only sodium bicarbonate, foaming in a clean boiler through the combination of three causes: (1) the separation in innumerable bubbles of the large amount of loosely combined CO_2, (2) the concentration of the liquid so as to produce considerable surface tension, and (3) the very rapid generation of steam in a boiler of inadequate steam space.

Foaming occasions such loss of water and of heat, creates so much danger to the boiler from uncertainty as to the height of water, detracts so much from the power and efficiency of the engine, and has left unremunerative so many dollars sunk in wells the water of which cannot be used, that the benefits to be derived from a determination of the causes of foaming, and therefore of its remedy, are great, and I believe the railroad world would thank the *Railroad Gazette* to gather and present all the individual bits of knowledge (and perhaps of speculation) so that from them we may form a complete and consistent theory.

Recent Practice in Rails.

Below is an abstract (from the September *Proceedings*) of the discussion on Rails at the London meeting of the American Society of Civil Engineers:

William R. Webster, M. Am. Soc. C. E.—From Mr. Hunt's discussion one might be led to believe that it was the usual practice to use high carbon steel in our rails. But such is not the case, as is shown by the fifteen American rail specifications given in the table prepared by Committee No. 1, of the American Section of the International Association. This table gives 0.45 per cent. to 0.55 per cent. carbon for the 100-lb. rails used by many of our railroads. Most of the rails are rolled to the sections of this Society, the rails of 70 lbs. per yard and under giving better satisfaction than the heavier rails. It seems to the speaker that this difference in results is due more to the higher finishing temperature in rolling the heavier sections of rails than to any other cause. This is a matter which the Society could take up and investigate to advantage.

As a check on the finishing temperature in rolling, the speaker suggests that a limiting clause be put in the specifications as to the percentage of shrinkage which will be allowed in a rail, from its finishing temperature in rolling to the normal temperature. This amount of shrinkage in a 30-ft. rail is a good measure of the finishing temperature, and it only remains to prove by experiment just how much shrinkage it is safe to allow. Or, in other words, what finishing temperature should be used to produce the best results.

It has been claimed by some who take an extreme view of the present practice, that we are now "hardening our rails by the carbon and squirting them through the rolls." But, as a matter of fact, we know better today than ever before the true bearing of the chemical elements on the physical properties of the steel, and the change of structure due to the mechanical work of rolling or forging at the proper finishing temperature.

The beneficial effects of finishing a heavy rail at the proper temperature are shown in re-rolling heavy rails which have not given good service in use. This is accounted for by the annealing action of the furnace in heating the rails up to a low heat for rolling, thus breaking up the coarse grain, and not heating high enough to form it again, the final work of rolling on the head is at a low temperature, the flange being in a condition to allow this work at the proper temperature.

The report of the English Committee appointed by the Board of Trade "To Inquire Into the Loss of Strength in Steel Rails Through Use on Railways," will appear shortly, and give us much valuable information. It will, no doubt, be the true starting point for international rail specifications.—[See *Railroad Gazette*, pp. 510, 526 and 561.]

Many of our specifications, at the present time, have ear-marks in them showing the suggestion of the manufacturers in one section as against those of another, or suggestions of the makers of basic Bessemer steel as against those making acid Bessemer steel. What is wanted is to get rid of all this and take the whole matter up on its merits from an engineering and metallurgical standpoint.

J. D. Smelt, M. Inst. C. E.—The speaker has had occasion recently to advise the Argentine Great Western Railway Company on the relative value of American and British tenders for rails. The section tendered upon, 72.8 lbs. per yard, was designed by the speaker in 1893, and has been rolled several times since that date in Great Britain and also in the United States. The inquiry was issued for rails to be manufactured to the speaker's specification. One of the leading American firms tendered in accordance with the Argentine Great Western section, but in accordance with their standard specification for quality. The differences between the two specifications are shown in the table, the chief differences being the high phosphorus and silicon of the American specification and the lower tensile strength and elongation, coupled with the somewhat inconsistently easy falling-weight test.

The price per ton quoted by the American firm was considerably lower than the British quotations, and the principal questions to decide were: First, what is the relative durability of 43-ton steel as compared with 38-ton steel; and, secondly, the amount of attendant risk due to the presence of high phosphorus and silicon, which, in a rail with a somewhat thin flange, might be considerable.

With regard to durability, it appeared to be approximately in proportion to the tensile strength, which is, in the speaker's opinion, independent of the means adopted to produce it; that is to say, it matters little whether the high or low tensile strength is due to the difference in temperature of the material during rolling, or to difference in chemical composition. Perhaps Mr. Hunt and other members can give some practical information on the subject.

In the Argentine Great Western rail, the speaker allowed for a wear of 5/8 in., and finds that the depth of the head of the American standard is about 5-16 in. less, which would appear to indicate about half the life, apart from the difference in tensile strength. With regad to fish-plates, the Argentine Great Western deep section was designed to make the joint of equivalent strength to the solid rail when worn and the results of tests prove the design to be correct in this respect. The American fish-plates of angular design cannot, therefore, be

TABLE I.—RESULTS OF TESTS MADE AT PARK LANE STORES, GATESHEAD, ON 18 PIECES OF NEW "HEMATITE" STEEL RAILS, FROM TOP, MIDDLE AND BOTTOM OF INGOTS, AS PER SIR LOWTHIAN BELL'S INSTRUCTIONS. TESTED JUNE 20TH, 1898; BALL, 1 TON; BEARINGS, 3 FT. APART

Distinguishing No. of rail	991		992		993		994		995		996	
Ingot No.	1		1		1		2		2		2	
Part of ingot taken from	Top.		Middle.		Bottom.		Top.		Middle.		Bottom.	
Results of tests	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.
	5 5 7 10 15 21	5/8 1 1/8 1 3/4 2 3/4 4 5/16 broke	5 5 7 10 15 21 27 ..	11/16 1 3/16 1 3/4 2 11/16 4 6 1/8 broke	5 5 7 10 15 21 27 ..	5/8 1 3/16 1 13/16 2 3/4 4 3/16 6 7/16 broke	5 5 7	11/16 1 1/4 broke	5 5 7 10 15 21	5/8 1 3/16 1 3/4 2 11/16 4 1/8 broke	5 5 7 10 15 21 27 27	11/16 1 1/8 1 3/4 2 5/8 4 1/16 6 1/4 9 11/16 broke
Sum of falling feet (breaking blow halved)	52½		76½		76½		13½		52½		103½	

Distinguishing No. of rail	997		998		999		1000		1001		1002	
Ingot No.	3		3		3		4		4		4	
Part of ingot taken from	Top.		Middle.		Bottom.		Top.		Middle.		Bottom.	
Results of tests	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.
	5 5 7 10 15 21	11/16 1 3/16 1 13/16 2 3/4 4 1/8 broke	5 5 7 10 15 21	11/16 1 3/16 1 13/16 2 3/4 4 3/16 broke	5 5 7 10 15 21	11/16 1 1/8 1 3/4 2 5/8 4 1/16 broke	5 5 7 10	11/16 1 3/16 1 7/8 broke	5 5 7 10 15 21 27 ..	11/16 1 3/16 1 13/16 2 3/4 4 3/16 6 7/16 broke	5 5 7 10 15 21 27 ..	5/8 1 1/8 1 13/16 2 3/4 4 3/16 6 1/2 broke ....
Sum of falling feet (breaking blow halved)	52½		52½		52½		22		76½		76½	

Distinguishing No. of rail	1003		1004		1005		1006		1007		1008	
Ingot No.	5		5		5		6		6		6	
Part of ingot taken from	Top.		Middle.		Bottom.		Top.		Middle.		Bottom.	
Results of tests	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.	Fall, ft.	Def., ins.
	5 5 7 10 15 21 27 ..	11/16 1 3/16 1 13/16 2 3/4 4 3/16 6 5/8 broke	5 5 7 10 15 21 27 ..	5/8 1 1/8 1 13/16 2 11/16 4 1/8 6 1/2 broke	5 5 7 10 15 21 27 ..	11/16 1 1/8 1 3/4 2 5/8 4 1/8 6 5/16 broke	5 5 7 10 15 21 27 ..	11/16 1 3/16 1 7/8 2 13/16 4 1/4 6 1/2 broke	5 5 7 10 15 21	5/8 1 1/8 1 3/4 2 11/16 4 1/8 broke	5 5 7 10 15 21 27 ..	5/8 1 1/16 1 11/16 2 9/16 3 15/16 6 broke ....
Sum of falling feet (breaking blow halved)	76½		76½		76½		76½		52½		76½	

Note.—These samples taken from six ingots, three out of each.

Composition—	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008
Phosphorus	0.043	0.048	0.043	0.040	0.044	0.053	0.043	0 050	0.051	0.059	0.073	0.070	0.060	0.060	0.059	0.057	0.070	0.062
Sulphur	0.050	0.060	0.070	0.050	0.060	0.060	0.070	0.060	0.060	0.060	0.060	0.060	0.050	0.060	0.050	0.040	0.050	0.050
Carbon	0.560	0.560	0.570	0.500	0.510	0.550	0.560	0.560	0.560	0.550	0.570	0.560	0.560	0.580	0.570	0.500	0.550	0 580
Silicon	0.069	0.066	0.067	0.072	0.072	0.064	0 081	0.069	0.069	0.066	0.072	0.063	0.069	0.066	0.063	0.072	0.087	0.084
Manganese	0.950	0.960	0.970	1.120	1.030	1.030	0 950	1.060	1.050	1.060	1.070	1.040	1.040	1.070	1.030	0.870	0.930	1.060
Arsenic	0.061	0.065	0.061	0.028	0.018	0.044	0.049	0.032	0.045	0.051	0.026	0.039	0.061	0.059	0.045	0.049	0 057	0.063
Iron by difference	98.267	98.241	98.229	98.290	98.266	98.179	98.247	98.169	98.165	98.154	98.129	98.168	98.160	98 105	98.183	98.412	98.256	98.101

The weight of the rail was 90 lbs. per yard, the length tested was 10 ft., and in each case the running head was up.

Table with Mr. Smelt's Remarks.

	Argentine Great Western.	American.
CHEMICAL COMPOSITION		
Carbon	0.4 to 0.5	0.4 to 0.5
Silicon	up to 0 08	up to 0.2
Sulphur	up to 0.06	up to 0.05
Phosphorus	up to 0.06	up to 0.10
Manganese	up to 1.0	0.7 to 0.9
FALLING WEIGHT TEST ON 3-FT. BEARINGS		
Weight of tup	2240 lbs.	2000 lbs.
Height of fall	13 ft.	17 ft.
Number of blows (without fracture)	4	1
Deflection under 1st blow	2 to 3 ins.	
" " 2d "	4 to 5 ins.	
TENSILE TEST		
Tensile strength (tons per square inch)	43	38
Elongation	12% in 10 ins.	12% in 2 ins.
Contraction of area	20%	

of the same relative strength, especially when taking into account the very soft material of which they are made.

John F. Wallace, President, Am. Soc. C. E.—Two of the American engineers who have spoken on this question represent inspecting consulting engineers, and one the manufacturers. The speaker would like to say one word from the purchasers' side. The railroads themselves, up to date, have had very little to say about the specifications of the rails used in America, and mainly on account of business reasons. The railways to the east of the Alleghany mountains have naturally been confined to the use of rails manufactured in that district, first, on account of the fact that the manufacturers were also the customers of the railroads, and produced a great deal of freight and traffic; and secondly, because they were nearer the point of consumption. The same controlling elements exist in the mills in the vicinity of Chicago. The roads of the West, tributary to Chicago, were naturally inclined to purchase rails from the Chicago mills, and the result has been that the roads east of the Allegheny Mountains have been compelled to use rails manufactured in their district, which could be manufactured from the ores east of that point; and the roads in the Mississippi Valley and the West have generally been confined to the use of the rails manufactured in Chicago. A great many roads have endeavored to enforce their own specifications. On the other hand, the mills have endeavored to require the railroads to accept their specifications, coupled with a guarantee that any rails affected during the period of five years should be replaced.

The railroads, to-day, through their engineers and their own special organization, which is looking after this particular matter, are now taking up the question of adopting specifications and asking the manufacturers to conform to them. The matter is now in the hands of a Committee of Engineers, who do not propose to draw up specifications which are impossible to fill; but intend to find out, from the character of the ores in different parts of the country, and from the processes of manufacture, what are the possibilities, and will endeavor to decide on specifications which are practical and common-sense. In the formation of such specifications, however, they expect to consult with the manufacturers and with the inspecting engineers.

In reference to phosphorus, some years ago on the Illinois Central Railroad, on a section of road where the traffic was exceedingly heavy, there was in use a 60-lb. rail, laid in 1878. Twenty years after that rail was laid, it was removed in order to replace it with an 85-lb. rail. The rail gave such extraordinarily good service that it was analyzed and found to run as high as 0.012 and 0.015 phosphorus—from 50 to 100 per cent. more than the specifications were then calling for.

Sir Lowthian Bell, M. Inst. C. E.—There are probably few questions connected with the manufacture and behavior of rails while in use which demand a more extended area of examination than those raised by Mr. Hunt. The opinions about to be given are those gathered from many years' experience as a manufacturer supplemented by a still longer experience as a director of one of the most important railroads in the United Kingdom. A life so spent seems to embrace all the conditions essential to the present discussion.

It may be well here to describe the mode of testing used in ascertaining the resistance to fracture offered by the rails under examination.

A weight of one ton (2,240 lbs.), and capable of being detached at any point of its travel, was raised by steam power between two girders of considerable height. The usual plan was to raise the weight a very few feet at first, and to increase the height of fall gradually, until fracture was effected. No account was taken of the acceleration of the fall, and therefore of the power, by the continued operation of gravitation, because this did not exhaust by any means the disturbing causes of the calculation. The chief of these is the unknown absorption of power by the deflection of the rail at each blow. The plan followed was to sum up the various falls and count the last at one-half its real amount. The estimate, therefore, is one of comparison only.

In evidence of irregularity in results the case of the trials of bull-headed steel rails of 90 lbs. per yard may be given. One of these gave way under a united fall of 23 ft., while a second one required for its fracture 199 ft. Chemical analyses of several specimens were made without throwing any light on this very great difference in the fall required for rupture. This will be best reserved for cases to be presently described.

Those members who have read the classic work of Prof. Henry Marion Howe, who confirmed observations made at the Clarence Works, will remember his description of the absorbing power of liquid steel in occluding gaseous matter, which latter was given off as the molten metal cooled. He naturally inferred that the uppermost portion of the ingot would contain the largest portion of the liberated gas which was imprisoned in spherical cells. When the ingot was rolled into a rail these cells were flattened but not entirely obliterated.

Trials were made by dividing each ingot into three parts, which were marked top, middle and bottom, and a rail was rolled from each. Six rails from each section were rolled and were exposed to the following test. A reference to Table No. 1 shows that the fractures took place as follows:

From the "Tops" at an average of 48.9 ft., "Middles" 64.5 ft., and the "Bottoms" 77 ft., and, further, that the analyses fail to connect these with any differences in chemical composition.

George Roberts Blanchard.

Mr. George R. Blanchard died at his home in New York City on Monday of this week at the age of 59. Mr. Blanchard had been disabled but a short time, although he suffered from a complication of serious diseases and his health had been in a precarious condition for several months; but he continued at work almost constantly. One of his last efforts was the argument before a committee of the Senate at Washington, in April last, at a public hearing on the Cullom Bill, the proposition to enlarge the powers of the Interstate Commerce Commission, which has been before Congress in one shape or another for several years. Mr. Blanchard's statement and arguments presented at that time were printed by Congress, making a useful compend of facts. The last work that Mr. Blanchard did before he died was in the preparation of an argument, on behalf of a number of railroads, to be presented to a committee of Congress which is now engaged in gathering information on the cost of transportation in the railroad mail service.

George Roberts Blanchard was born in 1841, at Rochester, N. Y., and had been a railroad man all his life. He began in the service of the Cincinnati & Chicago, at Richmond, Ind., in 1858, as clerk. Two years later he entered the employ of the Ohio & Mississippi and in four years had risen to be General Freight Agent. In May, 1864, he became General Freight Agent of the Central Ohio, and in 1867 General Freight Agent of the Baltimore & Ohio, later becoming Vice-President. In 1872 he went to the Erie as General Freight Agent, and for ten years following 1874, he was Vice-President of that company. Mr. Blanchard had become well known before he left the Erie, especially by his testimony before the Hepburn committee of the New York Legislature, which embraced an enormous mass of facts concerning railroad

George Roberts Blanchard.

transportation and rates; but the work by which he became even more widely known began after he left the Erie.

In February, 1886, he became Commissioner of the Central Traffic Association, with headquarters at Chicago, and a year later was made Chairman of the same Association. Here he conducted a great variety of the most difficult negotiations, and repeatedly held the traffic officers in line when, but for the effect of a powerful harmonizing influence, they would have broken out in open warfare. Judging by superficial results the ordinary historian would, very likely, declare the Association a partial failure, for its most laudable purposes often failed of fulfilment; and as the Chairman was deservedly credited for many of its successes one might plausibly assume that he should be charged with its failures. But every railroad man knows that at the very best a traffic association is at many times in its career nothing but an agency by which men try to sustain, in coherent shape, an agreement which is most fitly described as a rope of sand; and that great credit is often due to the principal participants if they do nothing better than make the best disposition of the sand after the rope has gone to pieces. We mention this phase of association work that the reader unacquainted with railroad affairs may understand that great credit is often due to an association manager for work which to outward appearance is a failure.

Mr. Blanchard remained in his Chicago position until the formation of the Joint Traffic Association, Jan. 1, 1896, when he came to New York. The history of this Association, which was expected to supersede both the Trunk Line and the Central Traffic Associations, in their most important relations to the public, is fresh in the mind of the reader. Mr. Blanchard was the executive officer of this Association throughout its short life. Besides his railroad positions he had various interests outside. He was president of the American Mutoscope & Biograph Company, a director of the United States Express Company, of the Standard Coupler Company and of the Safety Car Heating & Lighting Company.

Mr. Blanchard is probably best known to the public by various published arguments on transportation questions and especially by his testimony before the Hepburn committee already mentioned. This was afterwards published separately, and, though greatly abridged, made a large octavo volume. His knowledge of facts connected with the transportation business was phenomenal; he had spent his life in it, and he seems never to have forgotten anything. But it was not as a reasoner, or by capacity for developing principles from experience that he wielded his chief influence, but rather as a diplomatist, by his skill in conducting negotiations and in harmonizing conflicting interests. Of attractive presence and address, and extraordinary agility of mind, he commanded the attention of those with whom he dealt (who for the later years were largely the leading experts in transportation and the controlling officers of the great railroads) gained their good will, and in many cases doubtless secured united action where most men, even the ablest, would have failed. Although he entered railroad service in his boyhood, and had little opportunity for education in the schools, he was a man of considerable culture and remarkable refinement, with a social prestige unusual in his busy profession.

Notes on Maintenance of Way Engineering.

Setting Track Centers.

In the work of setting track centers for re-aligning track of an operated road there are several things to be kept in mind. The first one is always expense. The engineer's value or lack of value to his employer is largely measured by the amount which his work costs. If it costs $25 per mile to align track behind one engineer and $100 per mile behind another, there is apt to be a quiet inquiry, and unless the latter shows good reasons for his extra cost, his value to the company will go down. Often we have heard the cry of favoritism which was occasioned by the dismissal of some man who was a hard worker, worked long hours and worked hard, while some man was retained who "was sitting down alongside the roadbed half his time." If we could know the entire facts it might be that the discharged man was one who failed to rise to his position, and who gaged the cost of work by the amount his party expended on it.

The average cost of a party of three usually employed on M. of W. work is from $10 to $15 per day, depending on the amount of time lost getting to and from work, and other causes. They will average about two miles per day, one day with another, working eight to ten hours, and averaging the tangents and curves. A party of six section men will cost about the same as the engineer party, and will line up about one-quarter mile to one-half mile. Thus the trackmen's work is something like eight times as expensive as the engineers. This refers to the more simple work; it is often so heavy lining up that a section gang is unequal to it and it waits for the extra gang.

It is usually best to line a tangent by getting the centers on a bridge, if there be one, near each end of the tangent, otherwise take the center of the track, near each end of tangent, and unless it shows badly would let it run at that. If it looks badly when you get your instrument set up, it might be well to try a point say every thousand feet between the transit and other part and at each intermediate measure distance to rail. This will generally enable you to fix the points so as to most nearly fit the track as it exists. No exact rules can be laid down. Each case must be solved as it comes up, and most of them call for a large co-efficient of common sense.

In re-aligning curves it is usually necessary to run out the intersection, establish the P. I. and by measuring the external determine the degree of the curve, then determine and measure the semi-tangent or apex distance, set the P. T. and P. C. and run the curve. Sometimes the track is in such good alignment that the first curve run will fit all right. If you have a fear of this not being the case time can be saved by preparing a bunch of wooden pegs six or eight inches long and the size of a man's finger, sharpened, and set these by chain and instrument exactly in place. This will give you a chance to see if the curve will do, or if another is necessary what sort of change will be needed. If it fits satisfactorily it will not be necessary to re-chain the curve, as the hubs can be set in places of the pins. Any small error will be compensating and not accumulating. Should the error of the curve be all in one direction, that is, should your centers be all outside of the center of the track or all inside of it, and should it average five-tenths of a foot or over, it is probably best to figure a new curve. It is apparent that the track might require shifting over a foot and yet a new curve be undesirable, where one part of the curve is outside and another part inside of the present track centers, in which case nothing but a compound curve would help the centers. Unless it be a long curve or a very expensive place to change the grade, as on a high fill or in a rock cut it is not advisable to compound a curve to any extent, although a four degree curve might be made a four degree and ten minute curve on one end and a three degree and fifty minute curve on the

other on a line being lined up for betterment only and the curve much benefited and no harm done. But it is a thing to be done in an emergency only. The other matter is regular and at times it is even desirable to make a curve vary even a half minute, that is, if it were a 3° 10′ curve make it a 3° 09′ 30″ curve if it will better fit the track and save labor in lining track.

The problem is complicated when it is necessary to introduce spirals or easement curves. It can be planned for only when the method of spirals is known. Talbot's method, as developed by J. T. Mahl, and used on the Atlantic system of the Southern Pacific, is unusually simple, introducing no additional complications and not changing degree of the main curve. Searles' method is readily solved and applied, as, like all of Mr. Searles' problems, while they appear at first difficult of solution, they are wonderfully clear when finally worked out, and, with his tables, require few computations.

The prime difficulty arises when other problems enter in, as one occasion when the writer was re-aligning track on a section of a road where ten degree curves were common, some of them with over 100 degrees in central angle, where 100 ft. tangents between reverse curves were not unknown and where trestles had been replaced by high banks and no centers were run when it was done, but the track lined up by guess. He was asked to spiral all curves of two degrees and over, to secure 500 ft. tangents and to keep on the old grade. Of course, all were not possible to accomplish, yet by spending a good amount of time he was able to make a surprising (to him) approach to it. Don't be afraid to try again if the first is not satisfactory, and even if it be the seventh I would try again if I saw a chance of improving.

Birmingham, Ala. TRANSIT.

In determining the alignment of an operated road the cost and value of the improvement are to be balanced. Mr. Wellington considered the train resistance due to 1 deg. of curvature as equivalent to a 0.1 per cent. grade, or 2 lbs. per ton per degree of curvature. This puts a small premium on straight lines for the motive power department. In addition to this must be considered the increased wear on the wheels of the rolling stock, and the increased cost of maintenance of way, the tendency of the track to get out of line, the wear on the rails and ties and the greater liability to accidents. On estimates of the cost of these items an engineer may base his judgment. In places where other conditions limit the speed of trains, as city limits, yards, the character of the traffic, etc., a 6 deg. curve may be almost as desirable as a 1 deg. Where the location is the ruling point for high speed trains, it may be worth many thousands of dollars to simplify a curve or cut down its degree. Simple curves with spirals and separated by long tangents are necessary for the greatest comfort in passenger trains.

The cost of shifting track depends as much on local conditions as the value of shifting it. On a heavily operated road only 3 or 4 in. of throw can be made at a time and that has to be smoothed out to allow each train to pass. This means going over it three or four times to throw it a foot. On roads that maintain a standard cross-section this means new shoulders in fills, new ditches, trimming in cuts. Changing signal connections and the movement of bridge ticklers, mail cranes, drains, signs, etc., must be added in. A roadbed of uniform cross-section with its edge distinctly marked by some change of material, such as a line of sod or stone, adds greatly to an inspector's opinion of the line and surface of the track as the manner of serving a food affects our estimate of the food itself. A man in charge of track who is working for immediate results does not like to spend money for throwing track and after that doing much work before he gets it in as good a condition as when he started. It will always be hard to get men to work for results that may appear after their term in office has expired. These are conditions with which an engineer in charge of such location must contend. Engineering is cheap compared with labor. An ill-considered or wrong alignment destroys the confidence of the trackmen in the work laid out for them, weakens their ambition and hurts the morals of the crew. It pays to keep on trying until you are sure that the best solution possible is offered. The consequences of a bad decision keep on costing until it is rectified. As a road grows older and fixtures adjacent to the track increase a change costs more.

On a short curve a trained eye can usually note the determining points and decide whether to pull the curve in or out at that point, and if possible to balance up the throw and prevent rail cutting. If the first try doesn't hit it the second will. Set the transit over the gage of the rail and deflect around and see if it is already a simple curve. In running in compounds to fit existing track as closely as possible this last method is most valuable. After deflecting with some accuracy around the curve the P. C. Cs. may be closely approximated and the first try should be close. The finding of the P. C. may be hastened by stretching a string between points on the tangent and trying different places until one fits.

Where track is firmly fixed, as in rock ballast, it pays to spiral as low a curve as a 1 deg. There are many formulas and tables of spirals published—their only difference being in flexibility and ease of application. A spiral should be long enough to cover the change in elevation in the outer rail. However, each case must be decided for itself. A combination of two spirals with a short length of simple curve between them is not desirable.

Eighteen-inch hardwood stakes driven flush with the top of the ballast and centered with a brass tack, remain fairly solid during the winter months, but frost heaves them and they are always liable to heavy blows. The tacks should be checked whenever track is lined. As soon as possible after track is lined points within sight of each other should be fixed, either by a section of rail placed vertically in the ground, with the point marked on it, or by a stone monument—the chainage to the P. C. established and the notes fully reported.

In lining tangents when the entire distance can be seen, the problem of choosing one is usually easy. Foresights set at determining points such as bridges or objects and structures close to the track allow a man to stand at one end and move the transit around until he is on a line that satisfies as many of the conditions as possible. On a long line a base line may be run, distance and offsets to determining points noted and the proper location calculated. In lining the tangents, the line should be projected to a point where as much as possible of distance can be seen. Then a heliotrope or a transit used and points set about a thousand feet apart. With these as foresights a transitman can keep close enough to his rodman to center each tack. F. B.

Compressed-Air Haulage in Coal Mining.*

BY J. H. BOWDEN.

The shaft-plant here described was put in operation at the Colliery of the Susquehanna Coal Company, Glen Lyon, Pa., in September, 1895, and the No. 6 slope-motor was started in May, 1896. The plant comprises: One Norwalk three-stage compressor 12½, 9½ and 5 in. diameters of air and 20 in. diam. of steam cylinder, all 24 in. stroke; capacity at 100 revolutions, 296 cu. ft. of free air per minute, compressed to 600 lbs. per sq. in. A main pipe, 5 in. diam., 4,380 ft. long, with five charging stations, in No. 6 Shaft, and a branch of 3 in. pipe, 3,100 ft. long, with three charging stations, in No. 6 Slope. These pipes on each line charge a Porter compressed-air motor, with 7 x 14 in. cylinders, and four 24 in. drivers, weighing about eight tons, with a tank capacity of 130 cu. ft. of air at 550 lbs. pressure in the main tank, reduced to 160 lbs. in the 8-in. auxiliary tank of 4.2 cu. ft. capacity, supplying the cylinders. The No. 6 shaft run averages 4,000 ft. each way on grades of ½ to 2¾ per cent., and averaging close to 1 per cent. in favor of the loaded cars. The No. 6 slope run averages 2,100 ft. with nearly the same grades. The mine cars weigh 2,800 lbs. empty, and about 9,800 lbs. loaded, and are hauled in trips of 12 to 20, averaging about 15 cars. The shaft-motor now hauls about 355, and the slope motor 320 cars per day of 10 hours, replacing in the shaft 17 mules, and in the slope 15 mules, or, in all, 32 mules, against 27 replaced in 1896.

The average daily car and ton-mileage was:

	1896.	1897.	1898.
Tons hauled one mile, gross (including empty cars returned)	2,160	2,133	2,241
Net load	1,202	1,185	1,245

The use of steam and air in operating the compressor and motor was found by test to be:

Indicated horse-power at 131 revolutions of compressor	150	h. p.
Steam consumption per h. p. per hour, from cards	34	lbs.
Steam consumption per hour	5,100	"
Steam consumption per hour, including condensation in line	5,200	"
Roller horse-power required	174	b. h. p.
Evaporation per lb. of coal (cylinder boilers)	5	lbs.
Coal required per hour	1,040	"
Coal required per day, 10 hours	10,400	" 4.65 tons
Cost of fuel and firing per day (10 hours) 4.65 tons, at 50c	$2.32	

The free air compressed per revolution of compressor is 2.96 cu. ft. according to the calculation of the Norwalk Iron Works Co., no allowance being made for leakage.

The compressor works 12 hours per day; the motors 10 hours.

	Cu. feet.
Free air per minute at rated speed of 100 revolutions	296
Free air per minute at actual speed of 131 revolutions	387.8
Free air per day 12 hours at rated speed of 100 revolutions	213,120
Free air per day 12 hours actual speed of 131 revolutions	279,216

The capacity of the 5-in. line, 4,380 ft. long, is 608 cu. ft.; and that of the 3-in. line, 3,100 ft. long, is 159 cu. ft., making the total for both lines 767 cu. ft. At 600 lbs. pressure these lines hold 32,505 cu. ft. of free air. The capacity of the main and auxiliary tanks is 134.6 cu. ft. At 508 lbs. pressure (at which they will equalize with the main, starting to charge at 600 lbs.), this is equivalent to 4,845 cu. ft. free air. In standing 12 hours the pressure falls from 550 to 350 lbs., and of free air, 11,688 cu. ft., or 974 cu. ft. per hour, are lost. The proportion of this leakage to the total air compressed is 4.18 per cent.

According to a test made March 29, 1900, the amount of air used for the given amount of work was as follows:

	Shaft Motor.		
	No. 2 Plane.	No. 3 Plane.	Slope Motor.
Number of trips empty	3	10	16
Number of trips loaded	3	10	15
Average number of cars per trip, empty	15.33	12.7	11.4
Average number of cars per trip, loaded	13	13	11.3
Average cu. ft. of free air per trip, empty	1,724	5,686	1,230
Average cu. ft. of free air per trip, loaded	1,631	1,898	599
Average cu. ft. of free air per round trip	3,355	7,584	1,829

*Extracts from a paper presented at the August meeting of the Inst. of Mining Engineers.

At shaft No. 6, 356 cars were hauled per day in 1898; namely, from No. 2 plane, 6 trips of 15 cars each, using 20,130 cu. ft. of free air, and from No. 3 plane, 20 trips, averaging 13.2 cars each, using 151,680 cu. ft. of free air. The work at Slope No. 6 was 320 cars per day in 28 trips, averaging 11.4 cars each, and using 51,212 cu. ft. of free air, making a total for 676 cars of 223,022 cu. ft. of free air. The amount of free air apparently compressed for this work was 279,216 cu. ft., of which 83.4 per cent. is accounted for, leaving 16.6 per cent. for leakage and slip in the compressor, leakage in air-lines, and changes in temperature.

The average volume of free air used per ton-mile is as follows:

	Cu. ft.
No. 6 shaft-motor, gross	113
No. 6 shaft-motor, net	203
No. 6 slope-motor, gross	71
No. 6 slope-motor, net	128
Both motors, gross	100
Both motors, net	180

The greater quantity of air used by the shaft as compared with the slope-motor, is due to the heavier curves and the switching required, especially at No. 2 plane, where a portion of the trip is frequently left.

The cost of plant, not including steam boilers, was $15,156.

The cost per ton-mile was as follows:

	1897 (179 days).			1898 (160 days).		
	Daily Ton-Mileage.	Daily Cost.	Cost per Ton-Mile.	Daily Ton-Mileage.	Daily Cost.	Cost Per Ton-Mile.
			Cts.			Cts.
No. 6 shaft-motor, gross.	1,485	$11.12	0.75	1,527	$12.00	0.79
No. 6 shaft-motor, net..	825	11.12	1.35	845	12.00	1.42
No. 6 slope-motor, gross.	648	11.12	1.72	720	12.00	1.67
No. 6 slope-motor, net..	360	11.12	3.09	400	12.00	3.00
Both motors, gross	2,133	22.23	1.05	2,241	24.01	1.07
Both motors, net	1,185	22.23	1.89	1,245	24.01	1.93

Cost Per Ton-Miles By Mules.

	1897. Tonnage.			1898. Tonnage.		
	Ton Mileage.	Cost.	Cost per Ton-Mile.	Ton Mileage.	Cost.	Cost per Ton-Mile.
			Cts.			Cts.
No. 6 shaft—						
Gross	1,485	$33.94	2.29	1,527	$35.88	2.35
Net	825	33.94	4.11	845	35.88	4.25
No. 6 slope—						
Gross	648	29.35	4.53	720	31.08	4.32
Net	360	29.35	8.15	400	31.08	7.77
Total, gross	2,133	63.29	2.98	2,241	66.96	2.98
Net	1,185	63.29	5.34	1,245	66.96	5.38

Twelve-Wheel Wide Fire-Box Freight Locomotive—Buffalo, Rochester & Pittsburgh Ry.

The accompanying engravings show a new freight locomotive built by the Brooks Locomotive Works for the Buffalo, Rochester & Pittsburgh, which is the first example we have seen of a moderately wide fire-box applied to a twelve-wheeler. The engine is to burn bituminous slack coal. The cab is at the rear and is set well back, and the length of the engine and tender over all is 61 ft. 11½ in.

The same idea is carried out in this engine in respect to a moderate width of grate, as in the Prairie type of the Chicago, Burlington & Quincy, and the Northwestern type of the Chicago & Northwestern, but on account of the wheel arrangement of the 12-wheeler the fire-box is much shallower. From the top of the mud ring to the center of bottom tubes is a little over 14 in. It is now held by a few prominent men that for inferior grades of bituminous coal it is not only desirable to have a wide grate, but a deep fire-box is fully as essential, and it is an important thing to determine whether a sufficiently deep fire-box and wide grate can be applied to consolidation and 12-wheelers. Opinion differs on this point, and the engine shown is therefore of unusual interest. The Prairie type freight engines of the Burlington have a little over 49 sq. ft. of heating surface for each sq. ft. of grate; the Northwestern type passenger engines 65, and the 12-wheeler here shown has 43 sq. ft. of heating surface per unit of grate area.

As shown by the engraving the fire-box extends out over the driving wheels which are 55 in. in diam. The height of the center of the boiler above the rails is 9 ft. 1 in., or 7 in. less than in several recent locomotives. The diameter of the boiler at the front is 68 in.

The total weight in working order is 172,000 lbs., of which 139,000 lbs. are on the driving wheels; the cylinders are 20 x 26 in. and the working steam pressure 210 lbs. The boiler is of the Belpaire type. The fire-box is 108 in. long and 80 in. wide, 64 in. deep at the front and 48 in. deep at the back. No brick arch is used. There are 154.5 sq. ft. of heating surface in the fire-box, 2,361 sq. ft. in the tubes, or a total heating surface of 2,515.5 sq. ft.; the grate area is 58.9 sq. ft. Piston valves are used. The details of the boiler are clearly shown by the engraving.

The tender weighs 110,000 lbs. loaded and has a capacity for 12 tons of coal and 5,500 gals. of water.

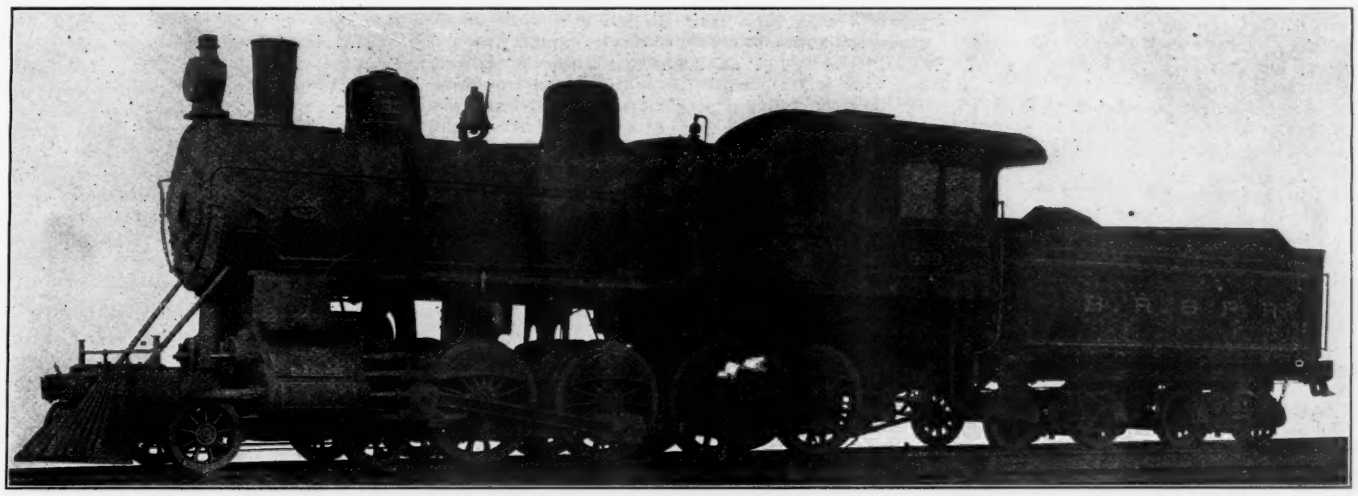
American Westinghouse brakes are used on the back of all driving wheels, and the other special equipment includes Michigan lubricators, Kunkle safety valves, Hancock "Composite" injector, A. French springs, Star headlight and United States metallic packing for piston rods.

Valve Motion, Backward Gear.

Lead, full gear	+ 3-32 in.
" 8-in. cut off	+ 13-64 in.
Port opening, 8-in. cut off	21-64 in.
Exhaust opens, 8-in. cut off	19 in.
Cut off, full gear	20⅞ in.

Tender.

Type	8 wheel, steel frame.
Tank, material	Steel.
" thickness of sheets	3-16 and ¼ in.
Type of under frame	10-in. steel channel.
" " truck	B. L. W., 100,000 lbs.



Wide Fire-Box Freight Locomotive —Buffalo, Rochester & Pittsburgh Ry.

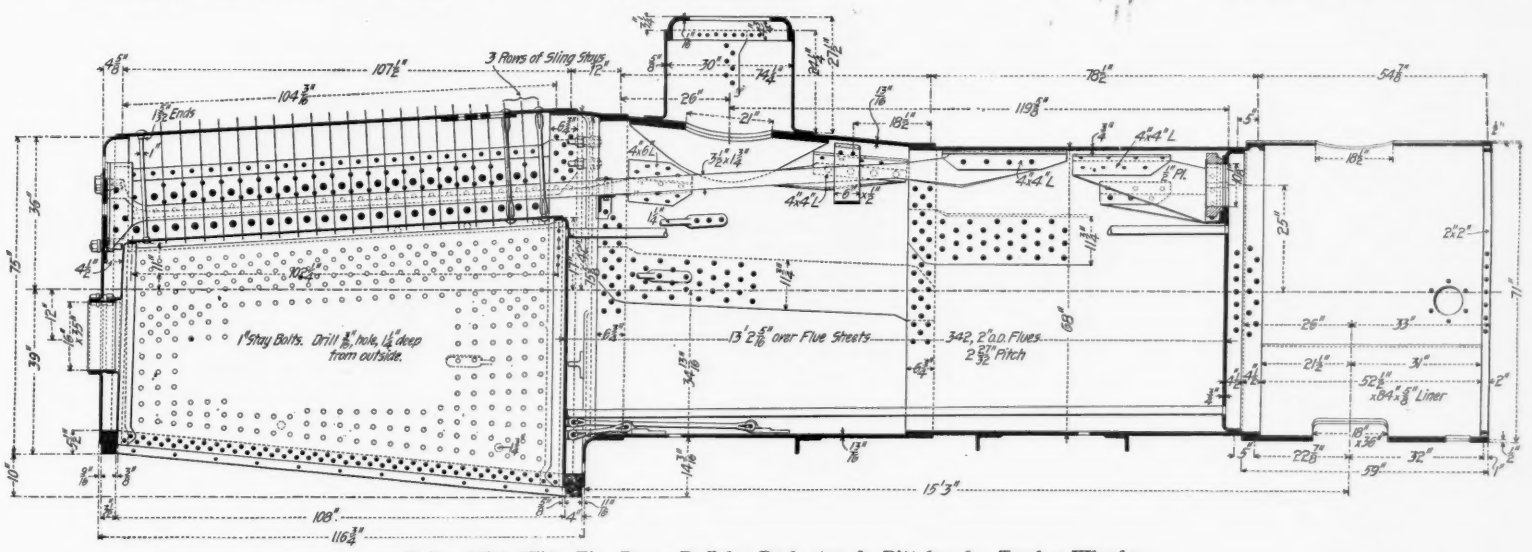
MR. C. E. TURNER, *Superintendent of Motive Power.* *Built by the* BROOKS LOCOMOTIVE WORKS, *Dunkirk, N.Y.*

The principal dimensions not given above are as follows:

Wheel base, total, of engine	25 ft. 8 in.
" " driving	15 ft. 6 in.
" total (engine and tender)	52 ft. 11¼ in.
Length over all, engine	38 ft. 8½ in.
" " total, engine and tender	61 ft. 11½ in.
Height of stack above rails	15 ft. 0 in.
Drivers, material of centers	Cast steel.
Truck wheels, diameter	30½ in.
Journals, driving axle	8½ x 10 in.
" truck "	5½ x 10 in.
Main crank pin, size	6¼ in. x 6 in.
" coupling pin, size	7 in. x 4¼ in.
" pin, diameter, wheel fit	7⅞ in.
Piston rod, diameter	4 in.
Main rod, length center to center	98½ in.
Steam ports, length	22 in.
" " width	2 in.
Exhaust ports, least area	75 sq. in.
Bridge, width	2⅝ in.
Valves, kind of	Improved piston.
" greatest travel	4 9-16 in.
" steam lap	⅞ in.
" exhaust lap or clearance	Line and line.

Boiler, material in shell	Steel.
" thickness of material in shell,	¾, 13-16, 11-16, ⅝ and 9-16 in.
" thickness of tube sheet	¾ in.
" diameter of shell, front	68 in.
" " " at throat	78⅛ in.
" " at back head	68⅛ in.
Seams, kind of horizontal	Sextuple, lap.
" " " circumferential	Triple, lap.
Crown sheet stayed with	Direct stays.
Dome, diameter	30 in.
Fire-box, material	Steel.
" thickness of sheets,	Crown, ⅜; tube, ⅝; sides and back, ⅜ in.
" mud ring, width,	Back, 3½; sides, 3½, and front, 4 in.
" water space at top,	Back, 4½; sides, 6½, and front, 4 in.
Grates, kind of	Cast iron rocking, in four sections.
Tubes, number	342
" material	Charcoal iron.
" outside diameter	2 in.
" thickness	No. 12 B. W. G.
" length over tube sheets	13 ft. 2 5-16 in.
Smoke-box, diameter, outside	71 in.
" length from flue sheet	63 in.

Type of springs	Triplicate elliptic.
Diameter of wheels	33½ in.
Diameter and length of journals	5 x 9 in.
Distance between centers of journals	65 in.
Diameter of wheel fit on axle	6⅜ in
Diameter of center of axle	5⅜ in.
Length of tender over bumper beams	21 ft. 1½ in.
Length of tank	19 ft. 6 in.
Width of tank	9 ft. 10 in.
Height of tank, not including collar	56 in.
Type of draw gear	M. C. B. Trojan.

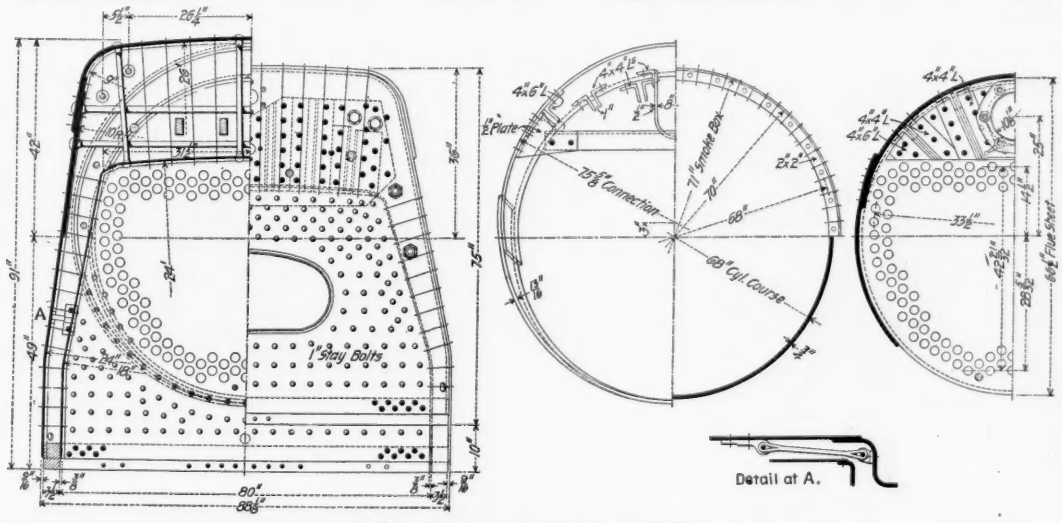


Boiler With Wide Fire-Box —Buffalo, Rochester & Pittsburgh Twelve-Wheeler.

Valve Motion, Forward Gear.

Lead, full gear	— 3-32 in.
" 6-in. cut off	+ 3-16 in.
Port opening, 6-in cut off	7-32 in.
Pre-admission, 6-in. cut off	9-16 in.
Exhaust opens, 6-in. cut off	17 7-16 in.
Cut off, full gear	22 1-16 in.

Exhaust nozzle	Player improved.
" " area	24.7 sq. in.
Netting	Wire.
" size of mesh	2¼ x 2½
Stack,	Steel taper.
" least diameter	18 in.
" greatest diameter	19¼ in.
" height above smoke-box	35 in.



Buffalo, Rochester & Pittsburgh Boiler.

Tests of Friction Draft Gear.

About two years ago, 50 large capacity wooden coke cars, in daily service between the Connellsville coke regions and Pittsburgh, were fitted with the Westinghouse friction draft gear. These cars have been in practically continuous service ever since, running generally together in a 50-car train. Although in hard service with powerful engines, the repairs to the draft rigging on these cars have been practically nothing and, compared with the same kind of cars without the friction draft gear, very satisfactory. In order to ascertain by practical tests, the condition of this draft gear after two years' service, and what results it would give in meeting severe requirements, an effort was recently made to get these cars all together for this purpose. It was at the time found impracticable to secure more than 47 of these cars, and with this number the following tests were made, without any previous preparation. The cars were tested just as they came out of service, the experiments being made on the Pennsylvania R. R. near Wilmerding.

With 47 empty cars, all air-braked and brakes coupled up, emergency stops were made at 20 and 30 miles an hour. Brakes on the six rear cars were then cut off and the emergency stops at 20 miles an hour repeated. Brakes on the rear 12, 18, and finally 24 cars were cut out and emergency stops made. In no case was there shock enough in the rear car to at all discommode the party of observers riding there. In fact, no blows or real shocks were at any time experienced. The last car came to a stop, when some of the braked cars were cut out, with a rapid retardation, caused by the unbraked cars running against those braked; but always with a yielding resistance or cushioning effect very different from the rigid, hard blow experienced with any form of spring draft gear under similar conditions. Not only did the party in the rear car experience no unpleasant effects but in no case was the slightest damage done to any part of the draft rigging or to the cars themselves.

The next experiment was designed to show the effect of imposing a sudden and severe pulling strain on this draft gear. The front 23 brakes were cut out and those on the rear 24 cars left cut in and in operation. A speed of upwards of 20 miles an hour was then attained when, without notice to the engineer and while the speed was being rapidly accelerated, the engine working under full head of steam, the rear angle cock was opened and an emergency application was made on the 24 rear cars only. The train was again brought to a stop with the engine throttle still wide open and without breaking anything. The engine used was a heavy Pennsylvania Railroad mogul carrying 185 lbs. of steam. In order to determine the capacity of the draft gear to resist jerks and suddenly imposed pulling strains, the engineer was asked whether he could break the train in two if the hand brakes on the last ten cars were set up hard and if he were permitted to take the slack against them and start ahead with the full power of the engine. He had no hesitation in saying that he could break the couplings with ease and evidently considered that those asking the question knew little of practical railroading. He was then asked to try. Although the rail was thoroughly sanded over the portion of track on which the engine must move, about 9 ft., the test was discontinued after six unsuccessful attempts with full head of steam, the engineer acknowledging that he was unable to do any damage to the couplings. The reason, of course, is plain. The power of the engine, even with taking the slack, owing to the almost complete absence of recoil in the Westinghouse friction draft gear, was unable to cause a strain sufficiently great between any two cars to exceed the strength of the couplers. On account of the capacity of the draft gear being so great, about 140,000 lbs., the engine could not exhaust it, and, therefore, never found anything solid to pull against. It is impossible to break a drawbar, or anything else, if, by reason of the yielding of the attachment to which it is fastened, the strain upon it cannot be made to exceed its strength. It is exactly this quality, combined with the absence of sensible recoil, that gives the Westinghouse friction draft gear its great value. These tests indicate that this device is not seriously, if at all, affected by a long period of continuous and hard service and on this account it is of especial interest and value to railroad men.

Some Notes on Rail Joint Fastenings.

BY F. C. SCHMITZ, ASSOC. M. AM. SOC. C. E.

(Continued from page 647.)

THE GENERAL REQUIREMENTS OF RAIL FASTENINGS.

Before proceeding to discuss the patented rail fastenings it might be well to look into the requirements of fastenings in general so that certain standards may be had clearly in mind, to which the joint in question must conform. In other words, an outline of ideals will be made to which each joint or class of joints may be compared. One of the surest ways of obtaining knowledge, concerning a given device, is by observing its action when doing the work for which it is designed. Consequently, before offering anything as to theoretical or other fixed requirements, the result of experiments made recently will be taken up.

Starting with the belief that any experiment to yield valuable results should be carried on under actual working conditions, no account has been taken of any investigations not so conducted. For instance, the results obtained at Purdue University some years since, on the effect of vertical non-balance of engine counterweights, showed only that an engine, mounted as was that one, lifted from the supports with a certain number of revolutions per second. That the same would be true of an engine rolling over a flexible track and drawing a load after it is entirely another matter.

The correct way to determine the point above referred to would be to register by an apparatus adapted for the purpose, the actual pressure of a driver on the rail while the engine was on its run, traveling at every possible speed and under varying conditions. Experiments made as outlined above would be very valuable in determining many things in connection with rail joints as was pointed out in a previous paper, and it is to be hoped that they will soon be made. All experiments, made by the writer, in investigating the rail joint question, have been carried out with instruments designed to test the joint in track, doing the work and enduring the stresses incidental to the operation of trains over it.

There are two methods to be followed in the experimental study of rail joints, the first of which is the examination of the physical condition of the quiescent or unloaded joint, the second of which is the examination of the action of the joint under the passage of a train.

Discussing the first of these methods, it is proposed to examine the unloaded joint and determine its profile for all possible conditions of roadbed, age, weight of rail, kind of ballast and ties, and amount of traffic. It is furthermore desirable to know, for each of the above conditions, what percentage of the total deflection is due to flow of metal and wear of rail head, what to permanent set of the bar, and what to cut of rail into the head of the bar.

For the determination of the points above, two pieces of apparatus were designed. The first called a "deflectograph" (see Fig. 29), was so constructed that it measured to the nearest thousandth inch, a variation in the profile of the rail ends, above or below a straight line connecting two points on the rail, 60 in. apart, or 30 in. each side the center of the joint. That the points were but 60 in. apart may be objected to by some as being a source of error. That such is not the case was early demonstrated in taking readings. What really shows the situation is the total deflection of the rail ends below the average surface of the rail. The permanent set rarely extends further back, from the rail ends, than 16 in. Consequently two points 60 in. apart represent as well as any other two points, the average surface of the rail. New rails vary a hundredth of an inch in surface, therefore there is always a possibility that the recorded deflections are in error half that amount. It is so small a figure, however, that it in no wise affects final results.

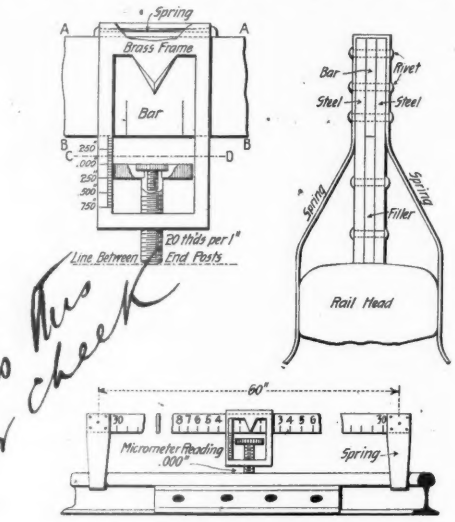


Fig. 29.—Schmitz Deflectograph.

The following system of tests was mapped out in the beginning, in order that the information when completed might be comprehensive.

(1) For each of the several kinds of ballast, weights of rail and amounts of traffic, what is the effect of age?

(2) For each of the several weights of rail, ages and amounts of traffic, what is the effect of ballast?

(3) For each of the several weights of rail, ages and kinds of ballast, what is the effect of traffic?

(4) For each of the various kinds of ballast, ages and amounts of traffic, what is the effect of weight of rail?

As far as the experiments were completed the following answers cover the above questions:

(1) Deterioration begins immediately after laying and increases uniformly with age. It takes the form of a slight dip at the rail ends, that extends farther back each year until the rail finally becomes unfit for service. The deterioration is slower in some cases than others, but is uniform for each condition.

(2) For all the various conditions of traffic, weights of rail and age, deterioration was most rapid in gravel ballast, least rapid with broken stone, while blast furnace slag was between the two. It was, however, pronounced in all kinds of ballast as the age increased. That it was least in broken stone shows that the latter distributes the pressure better than any other type of ballast. What the exact ratio of distribution is between the several kinds of ballast, has not been settled, although some experiments have been made in Germany with a model that were not satisfactory. It is sincerely to be hoped that some one will soon make some experiments on the distributing power of ballast that are carried out in actual track under moving trains.

(3) The effect of traffic, other conditions being constant, is, an increase in deterioration, directly in proportion to the increase in traffic.

(4) For each of the many conditions of traffic, age, and ballast, deterioration was more rapid the lighter the rail section, provided the rails were equal in quality, chemical composition, etc.

The second piece of apparatus, called the "rail micrometer" (see Fig. 30) was designed to determine the percentage of total deflection, under all the conditions outlined above, that is due to flow of metal in rail head, also abrasion of same under wheels. Not enough readings

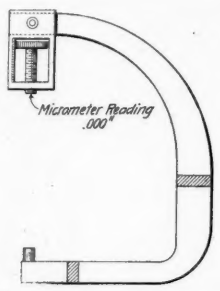


Fig. 30.—Rail Micrometer.

have as yet been taken with the apparatus to cover the ground. What has been done, however, shows that the first bend is due to the flow of metal in rail head, which takes place with any type of joint or weight of rail.

As a further proof of the above point, the following experiment would doubtless be found both interesting and instructive. Make a transverse cut through the head of a rail in service, with a fine saw, leaving the web and base of rail intact, add a pair of splices just as at a joint in the track. The cut if possible should be not over .01 in. wide. The rail and splices under such a condition would be as stiff as the rest of the rail, and should a depression appear it could be due to no other cause than the flow and abrasion of metal in the rail head. That the depression would appear is a firm conviction of many railroad men.

So much for the story of the quiescent joint and the history of the effect of loads as seen by its condition.

The next phase of the situation requiring study, is the examination of joints under stress, to determine, if possible, what there are in the conditions of service that could produce the physical results noted in quiescent joints. To best get at the results and to make the information complete the following points were observed, namely:

What stresses the joints endure.

What is the effect of rapidity in applying loads?

What additional load is thrown into the joint for the different positions of counterweight?

What is the actual total deflection under various loads?

What is the relation between the deflection of a joint and of the body of the rail?

How well the joint compels the rail ends to act together.

What special features of the conditions of service each experiment shows that others do not show.

All the above observations were taken under as many varying conditions of traffic, weight of rail, subgrade, ballast, ties, etc., as possible. In designing a piece of apparatus to give the above information it was thought that the results would be more comprehensive, if the record of the load were taken from the center of one rail to the center of the next. The apparatus was so built, therefore, that it registered automatically the synchronous total deflections in the ballast of nine points on

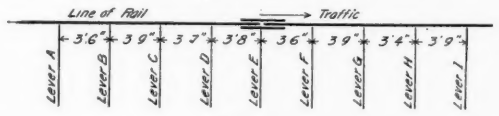


Fig. 31.

the rail, 3½ ft. apart, more or less, the center point being as shown in the sketch, Fig. 31.

To illustrate the kind of results obtained, Fig. 32 is shown, traced directly from the records. The most striking fact, brought out in the plot, is the wide variation in

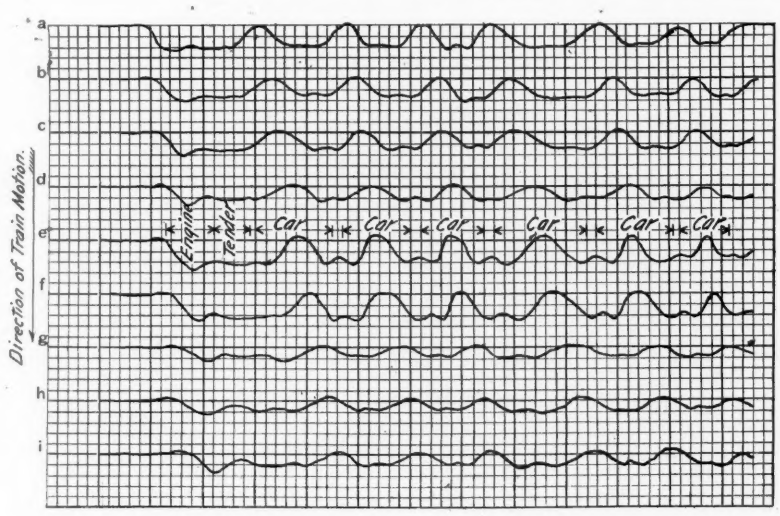


Fig. 32.—Synchronous Rail Deflections Under a Train.

(Vertical Scale Half Size.)

Weight of rail 70 lbs., Pennsylvania R. R. section; six-hole angle-bar joint; alignment, tangent; ties, oak; ballast, stone; engine, Class R.; speed 35 miles per hour; joint and rail in good condition.

the total deflection in the ballast at different points along the rail; also the great deflection and rapid recovery at the joint. The former is due to a difference in tamping ties; the latter to the weakened section at the rail ends.

The difference in tamping ties is the cause of much of the roll and side motion of cars at high speeds, as well as of excessive tractive force required to move cars at low speeds, i. e., starting. Elsewhere it has been stated that the perfect track is not that which allows of no deflection, either of rail or tie in ballast, but rather, that in which the deflection is absolutely uniform throughout its entire length. Could this delightful state of affairs be even slightly approximated, smooth riding track would be much more of a reality than it is at present.

A careful analysis of many readings on rails, taken with the "synchronograph," shows that the following conditions hold with angle bar splices:

1. Tension in the top fibers is comparatively slight.
2. The stress that causes the failure in the top fibers is compression.
3. Owing to the weakened section at the joint, deflection and recovery are more rapid as well as more pronounced; hence the stresses are higher.
4. Resulting from 3, the increased motion deteriorates tie bearing and causes excessive maintenance cost.
5. With base-bearing joints the condition at rail ends approaches very nearly that in the body of the rail.
6. The stiffer rail sections give less total motion and more uniform deflection at all points.
7. Stone ballast gives better bearing and allows of less tie motion than any other type of ballast.

Above it was stated that the distributing power of ballast is still an unsettled question. As far as the readings of the deflectograph go, they indicate that rail joints deteriorate, with a given traffic, weight of rail, maintenance cost, etc., at a much slower rate on stone ballast than on any other kind. A set of experiments, conducted under working conditions, has for some time been in contemplation by the writer, by which it is proposed to examine the distributing power of ballasts under as many conditions of traffic size of rail, tamping, cross-section, ties, etc., as possible. The results will be tabulated or plotted graphically so that direct comparisons may be made. By this means it is hoped that data may be deduced that will give some comprehensive information on the subject.

To the results obtained by experiment must be added those obtained by observation backed by experience. In this way many new requirements are imposed on the joint and the validity of many conditions, shown to exist by experiment, are made more apparent.

The first of these is the question of expansion and contraction due to changes in temperature. It is manifestly impossible to make a joint that shall be efficient against both upward and downward bending, without restricting the movement of rail under the influence of heat. Minor changes in temperature may readily be taken up in stressing the rail either in compression or tension. There is a limit to the elongation that may thus be disposed of, however, and beyond this limit the rail must slide in the fastening, rather than buckle out of line in its center. In other words, the bolts must not be tight enough to buckle the rail, under any circumstances.

The question then arises, is it possible to make a joint, in which the bolt may be left loose enough to allow of the above expansion, and yet be tight enough to make the whole device efficient? That it is possible, and that the joint so built not only is as efficient but more efficient than the old-style angle bar with bolts tightened to the extremity, will be shown later in the discussion.

The second point brought out by observation and confirmed by experiment, is that the common angle bar fastening has not enough bearing area under the head to prevent crushing. Therefore, a joint should bear under the base of rail as well as under the head.

Third, a joint must be capable of taking up the irregularities pointed out as existing in rail sections. In other words, there must be a certain adjustment between rail ends and fastening. A further application of the same point, dictates that wherever two parts of the device come in contact the same rule should hold good.

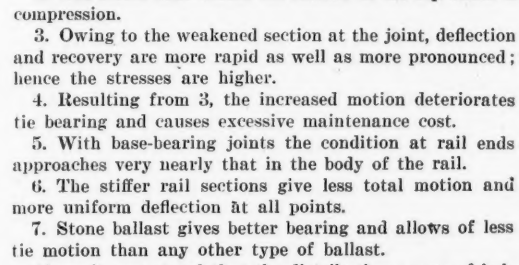


Fig. 33.—Master Mechanics' Standard Tire.

Fourth, The joint must compel the rail ends to act the same as the body of the rail in the transmission of the wave motion. Experiment shows that there is, at certain times during the passage of an engine or car, tension in the top fibers of the joint. There must, therefore, be a bending tendency vertically in both directions. To overcome this and keep the abutting rail ends always at an equal level, the joint must have a bearing on top of the foot as well as under the head.

Fifth, The joint should offer no surface for the wheel to run on, other than the head of the main rail. It is an impossibility to keep the tires of engine and car wheels to their true cross-sections; as a consequence, the majority of the wheels in actual service approach closely the condition shown in Fig. 33, a false flange appearing outside the head of rail. If now, the joint fastening offer an additional bearing area for the wheel, there must in all but one case be a lift of the wheel. That this is so is perfectly clear, because, if the device is so constructed that it has a bearing against a new wheel, no other wheel can exactly fit the conditions imposed. Worn wheels exist and must be taken into account in discussing the efficiency of a type of fastening.

Sixth, A joint device should be simple, easy of application and renewal, and should not be dependent upon the adjustment of one part against another. That a joint fastening should be simple and easy of application and renewal, hardly needs discussion. It is obviously impossible to accomplish much in the way of handling complicated track fixtures with the class of labor usually employed to lay and renew track. There should be but one possible way to apply the fastening to the rail ends so that no chance exists for an error. While the probability of a wreck from a joint device being applied wrong is remote, the possibility is there and the risk should not be taken.

That a joint fastening should be capable of removal without disturbing the rails must also be conceded without argument.

The third part of the sixth condition requires a little explanation. In a former paragraph, it was stated that a joint always should have a certain adjustment between parts in actual contact, while here is a condition seemingly of an opposite kind. It is necessary that a joint be capable of absorbing the irregularities in its own structure as well as those of the rail. It is not necessary or desirable that the efficiency of the whole device should depend on the adjustment of a single piece; be that piece a bolt, a truss rod or what not.

Seventh, A joint should not require a special arrangement of other track materials. In other words, it should not be necessary to space or line ties before application. The rail should not be surfaced before final application. The joint should not require either support or suspension. There should be no interference with the free use of a tamping pick. The absence of tie support should not materially injure the fastening, more than it would the body of the rail. These are all points that are either so familiar as not to require discussion, or have been taken up and disposed of in other ways.

Eighth, A joint should not require a special form of rail end. There are three fundamental forms of rail ends as shown in Fig. 34. All other forms are but modifications

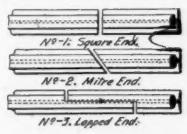


Fig. 34.

of these three. No. 1, or the square cut, is in use in all but a few cases the world over. The mitre and lapped end are special and are to be avoided. United States railroads have had little experience with the mitre end and less with the lapped end. The Lehigh Valley has made the most exhaustive trial of any road with the mitred rail end and has given it up as not being satisfactory. At present it is the universal opinion of railroad men that the mitred or lapped end has disadvantages that more than overcome whatever slight additional support it may give to the wheels. In case of wrecks, short rails, cutting in a new siding or any other kind of repair work, it is very inconvenient to match the mitred or lapping end of old material. It is not easy with the tools available in the field to cut a mitre end, and not possible to cut a lapped end. A further serious criticism of the latter is that the rail heads tend to spread apart when they are lapped, under the rolling pressure of many wheels. Furthermore the right angled corner is always a source of weakness in metal. The special rail end, therefore, has no place in modern railway track.

Ninth, A joint must have sufficient vertical rigidity to insure a total deflection of rail ends and fastening equal to, but no greater than, that obtained in the body of the rail, for a given load. The proper determination of the percentage of a load carried by fastening and rail ends respectively, depends on the equation of deflections. With a load W at the joint, a certain proportion W_1 will be carried by the fastening acting approximately as a beam fixed at the ends, while the rest of the load, W_2, will be carried by the rail ends acting as cantilevers, each carrying $\frac{W_2}{2}$. Therefore, the deflection, $= \theta$ of the rail ends is expressed by the following formula, I being the moment of inertia of the rail and E the modulus:

$$\theta = 1/3 \left\{ \left(\frac{W_2}{2} \times \frac{l^3}{8} \right) \div E I \right\} = \frac{W_2 \, l^3}{48 \, E \, I.}$$

Likewise the deflection of the joint due to load W_1 is represented by the following formula, I_1 being the moment of inertia of the joint and E the modulus, θ_1 being the deflection and equal to θ

$$\theta_1 = \frac{W_1 \, l^3}{192 \, E \, I_1}$$

Equating and we have

$$\frac{W_2 \, l^3}{48 \, E \, I} = \frac{W_1 \, l^3}{192 \, E \, I_1} \text{ or } \frac{W_2}{W_1} = \frac{48 \, E \, I}{192 \, E \, I_1}$$

E may be assumed equal for both kinds of steel, hence

$$\frac{W_2}{W_1} = \frac{I}{4 \, I_1}.$$

Hence, if we know the moments of inertia of both rail and splice, it becomes very easy to find the percentage of load each carries.

Considering the allowable deflection in the body of the rail as a fixed quantity and determining the load that the rail ends will carry for an equal deflection, which load equals W_2, we may readily for a given rail, determine the necessary moment of inertia for the fastening to give the required vertical stiffness.

For an A. S. C. E. standard 100-lb. rail I^1 should be .65 I.

Summarizing what has just been discussed we find the following conditions under which all rail joints must operate:

1. The joint must be efficient without stressing bolts beyond what is required to hold the joints firmly to the rail when unloaded, thus insuring proper expansion and contraction.
2. The joint should have proper bearing area to prevent cutting of rail head into splice.
3. The joint must take up the irregularities in rail sections.
4. The joint must hold the rail ends in such a manner that they act as the body of the rail in resisting bending upward as well as downward.
5. The joint should in no wise alter the running width of rail head.
6. The joint should be simple, easy of application and renewal and should not depend on the adjustment of one part against another.
7. The joint should require no special arrangement of track materials.
8. The joint should not require a special form of rail end.
9. The joint must have sufficient vertical rigidity to insure, for a given load, a deflection equal to but no greater than is obtained in the body of the rail.

(To be continued.)

New Railroad Building in Minnesota.

Minnesota is sharing in the increased activity of railroad building with other sections of the country. Last year 374 miles of new road was completed in the state. During the first six months of this year 130 miles was added. There are at present seven old companies and two new ones at work on lines which will aggregate 250 miles. Numerous other lines are proposed, some of which will no doubt take form in the near future. These include eight by old companies and 12 by companies recently incorporated. The aggregate of railroads proposed and building within the state exceeds 2,000 miles.

Prior to 1898, when 262 miles was added to the railroads of the state, the building for several years was comparatively light. For the five years from 1893 to 1897 inclusive the total mileage of new roads was 318, which was less by 56 miles than the additions of the single year 1899. Minnesota's record year of railroad building was 1886, when 544 miles was added. Nearly as much, 520 miles, was built in 1871. Excluding these two years, last year's record of 374 miles was exceeded only in 1879 with 473 miles, and in 1882 with 397 miles. The first railroad built in the state was in 1863 when 31 miles was completed. At the end of 1870 the total was 1,092 miles; in 1880, 3,151 miles; in 1890, 5,545 miles, and in 1898, 6,403 miles. This is the latest record of "Poor's Manual." Since that date the new building has made the present mileage in excess of 6,900 miles. The latest report of the Interstate Commerce Commission credits the state on June 30, 1898, with an average of 7.85 miles of railroad for each 100 square miles of territory, and 41.18 miles for each 10,000 population. The corresponding figures for the entire United States, exclusive of Alaska and outlying possessions, were 6.28 and 25.61 miles respectively, which shows that Minnesota is somewhat better served with railroads than the country as a whole.

The Burlington, Cedar Rapids & Northern is building two extensions within the state. One is a cut-off from Albert Lea on the northwest branch to run southwest 44 miles to Germania, Iowa, on the main line to Sioux Falls and Watertown, S. Dak. The present connecting point between the two sections is Vinton, Iowa, 23 miles northwest of Cedar Rapids. Vinton is 132 miles from Albert Lea and 167 miles from Germania. Grading was begun this season and the line is practically completed. The other extension is from Albert Lea north toward St. Paul and Minneapolis. The Cedar Rapids now gets into these cities over the Minneapolis & St. Louis. A contract was let in July for the section from Albert Lea north 48 miles via Owatonna and Medford to Faribault, and building is in progress. This will take the line within about 50 miles of the "Twin Cities." From Owatonna to Faribault, 15 miles, it parallels the Chicago, Milwaukee & St. Paul.

A line under construction by the Great Northern is to parallel the Duluth, Missabe & Northern, a road controlled by the Lake Superior Consolidated Iron Mines. The new branch will run from Stony Brook, on the Eastern of Minnesota main line, 58 miles northwest of Duluth, and will extend northward within three miles of its competing line. It will pass through Columbia Junction to Nelson, 50 miles. The Great Northern already taps this territory through a less direct line southwest via Hibbing to the main line at Swan River, some 34 miles northwest of the junction point of the new line. The line from Hibbing east 20 miles to Virginia, near the terminus of the proposed new branch, was built last season.

The Illinois Central has begun building a line which for practically the first time brings that company's tracks within the state. Two branches of the Dubuque & Sioux City touch the southern boundary line of Minnesota, one from Waterloo, Iowa, north to Lyle on the southeastern border, and the other from Cherokee northwest to the southwestern corner of the state and thence to Sioux Falls, S. Dak. The Lyle branch is being extended under the title of the Albert Lea & Southern from Lyle northwest 21 miles via Glenville to Albert Lea. There it will tap the Minneapolis & St. Louis, which fact leads some to accept the report that there is an agreement between the two companies. An interesting fact in this connection is that the Minneapolis & St. Louis has just completed an extension from New Ulm, Minn., south to a connection with the Illinois Central's line at Storm Lake, Iowa. Over the tracks of the Minneapolis & St. Louis the Illinois Central would have direct connection from Albert Lea with St. Paul and Minneapolis. Grading is practically completed on this extension and track is being laid.

The Itasca Lumber Company, which has built a logging road from Deer River, on the Great Northern, north 20 miles, is building an extension of 11 miles to Turtle Lake. A further extension of 15 miles is proposed to Big Fork River. Track is to be laid this year to Turtle Lake. A branch is building from the main line to Jessie Lake, five miles. Last year the Red Lake Transportation Co. completed its line from Red Lake south 10 miles to Nebish. It has nearly finished six miles more this year to White Fish. The Brainerd & Northern Minnesota has just let contracts for an extension into this same territory. The road now runs from Brainerd, on the Northern Pacific, north 92 miles to Bemidji, on the Great Northern. The extension is from Bemidji northeast 91 miles, and to the east of Red Lake to the Big Fork River, a tributary to Rainy River on the Canadian boundary. It is stated that 37 miles is to be finished this year and the rest next spring. Connection is to be made at some point with the line of the Red Lake Transportation Company. This extension is being built under the title of the Minnesota & International, which was recently incorporated, it is said, by officers of the Northern Pacific. As that company recently made a traffic agreement with the Brainerd & Northern Minnesota to cover the transportation of several million feet of logs, it is not improbable that a closer agreement between the two companies may ultimately be effected.

The Canadian Northern, which is the proposed transcontinental rival of the Canadian Pacific, and is building by Mackenzie, Mann & Co., of Toronto, has been completed from Winnipeg, southeast across Manitoba and to War Road in Minnesota, some 15 miles from the International boundary. It is to pass around the south side of the Lake of the Woods and into Canada again at some point near the mouth of the Rainy River, where connection will be made with the line building west from Lake Superior. The American section is called the Minnesota & Manitoba. The plans include a branch south to Duluth. The American section to the Rainy River will be completed this year.

Under the title of the Duluth & Northern Minnesota, Alger, Smith & Company, of Detroit, Mich., are building a lumber road from Knife River, on the northern shore of Lake Superior, to run north into timber. Twenty miles of main line and 10 miles of branches are completed and in operation. Another new line is the Gulf & Manitoba. It was incorporated in 1899 to run from the Iowa state line south of the village of Jackson, north about 167 miles to Sauk Center and thence to Duluth. Charters have been filed in other states for an extension south through Iowa and Missouri to Kansas City. Work was begun last year between North Redwood and Beaver Falls, and considerable grading is completed on that section. The State Railroad Commission has authorized the company to increase its capital stock to $7,000,000 and to make a trust deed for $21,000,000 on bonds to be issued on the completed road.

Another road of extensive plans is the Duluth & New Orleans, which is projected from Duluth entirely across the country to New Orleans, La. Contracts are let for work in Iowa and building is in progress in that state. The Duluth, St. Cloud, Glencoe & Mankato is reported about to let contracts for a portion of its proposed line from Duluth southwest about 200 miles to St. Cloud, and thence south 100 miles to Mankato. Preliminary surveys are said to be completed and right of way mostly secured between Mankato and St. Cloud. A company, reported backed by the Minneapolis, St. Paul & Sault Ste. Marie was incorporated last spring to build from Elbow Lake, or some other point on the "Soo" line, northwest through Fargo, N. Dak., and across the state. A branch is proposed from Fargo northeast to Duluth.

Among the projected extensions of the older companies is one by the Chicago, Milwaukee & St. Paul from St. Paul and Minneapolis north about 160 miles to Duluth. Nothing has been done beyond making surveys. The Duluth & Iron Range is considering an extension from Virginia westward along the Mesaba range. The Great Northern also has under consideration an extension from Virginia to run east about 70 miles to Beaver Bay on Lake Superior. It may build from New Paynesville north about 20 miles to Melrose. The South St. Paul Belt is at work on estimates for an extension from South St. Paul north five miles across the Mississippi and into the city of St. Paul. Congress has granted permission for the At Minneapolis the Chicago & Northwestern has submitted plans to the United States Government officers for a line south into Fort Snelling.

Metal Cars.

At the September meeting of the Northwest Railway Club the question of metal car construction was discussed, and what follows is taken from that discussion.

Mr. C. A. Seley, Mechanical Engineer, Norfolk & Western: The road with which I am connected is one of the heaviest coal carrying roads in the country, its total annual tonnage exceeding that, I believe, of either the Northern Pacific or Great Northern. We have found it necessary to use large capacity cars. A little over a year ago a design was made for a 100,000-lb. car, using standard rolled sections for the under frame and a wooden hopper. We built 1,000 of these cars at the shops of the company, and have them all in service now, the last having been completed early this year. We are running them in solid trains, carrying about 2,000 tons over a maximum grade of perhaps 66 ft., using double-headers over a large portion of the road. It has brought out a great many interesting questions. There were a few errors in the design, which will be corrected in any future cars, and some errors which we had to correct soon after the cars got into service, but not at all from the class of material used.

There have been many criticisms of rolled sections in car construction, particularly from those interested in other types of construction, and other designers who have been anxious to have the members made in such a way as to distribute the material to properly carry the strains with the minimum of material. This, of course, necessitates an irregular section, and cannot be produced economically in the rolled section. We all know that a fish-bellied beam, light at the ends, will carry as much as a good deal more material of a uniform section. But I thoroughly believe that in shaping the material there are strains put into it in making it assume that shape, that no person can tell whether it will carry its figured amount of not, and I do not believe in the majority of cases that it will. In transmitting stresses with a form of section that you can get bearing to bearing, transmitting the stress through the sections with a full bearing in all cases, better results can be obtained than if the material is such as to carry the stress through round corners which do not permit full bearing. Our large cars have been performing their business with no repairs whatever, except that due to wreck.

I have made more recently a design of a drop-door gondola, the 100,000-lb. cars referred to are hopper-bottom cars. The drop-door gondola is 80,000 lbs. capacity, made entirely of rolled sections and standard plates and sizes of steel, with a wooden floor and lining, and I use a truss construction on the sides, doing away with the wooden stakes and heavy side sills, and have produced a car which carries a 73 per cent. revenue load. I think it is entirely feasible to use the product of the rolling mills in car construction of over 60,000 lbs. capacity, if it is desired to get a high revenue-carrying capacity. In all or most of the 60,000-lb. cars nowadays, we find all steel trucks, and we can employ steel to some extent in 60,000-lb. cars. It is the practice of the Norfolk & Western road to put in I beams in the ends of box cars to stiffen the ends, and this has been done for some years. It does not employ steel for the framing further than that on 60,000-lb. cars, but I do not think that it will build any 80,000-lb. or larger capacity without using steel frames.

The use of wood for the hopper has been forced upon us by two principal reasons. Most all soft coal has more or less acid in it, which will deteriorate a steel hopper, and we find that wood will not wear out. It will last its natural life in coal service, and then has to be replaced on account of age. That means that the wood will last eight years, and I do not believe that in carrying soft coal for eight years that a single steel hopper will be found entire; there will be some holes in it. Then again, the cost of the steel, compared with the wood, makes it almost prohibitory. We use 2¾-in. lumber for the big hopper; I think that could be reduced somewhat, as I have used successfully 1¾-in. on the gondola, with a 4 ft. 6 in. side. And the cost per square foot for that lumber as compared with steel to take its place, as prices were six months ago, is ten to one in favor of wood. It is not that ratio now, because steel has dropped a little. The wood hopper also adds a facility for repairs. Our steel frames are all riveted up so that there is very little excuse for the car repairers to do much work in ordinary running repairs to steel cars. Their main work, of course, is done on the trucks, but in case of repairs to hoppers, it is of a material that can be handled with the ordinary facilities.

The evolution of the car is bringing about a reconstruction and re-arrangement generally of the repair facilities. Our present repair track facilities are not such as can properly take care of steel cars. Even now, the repairs to the steel trucks under 60,000-lb. cars are expensive, due, perhaps, to the facilities being no better than when wood was a large portion of the material of the truck. But the steel car is bound to stay, and we have to equip our repair tracks with facilities for handling it, the same as we have equipped our locomotive shops for handling the larger and different types of engines that are coming into service with the evolution of larger power. The workmanship on the cars is such as is ordinarily done on bridge work. It is not as good as boiler work. We do not expect to have a boiler rivet, and we do not get as tight joints as we get on boiler work.

I would not say particularly as to the cost of these cars. It must be admitted that they cost more than wooden cars. But we expect longer life and greater service, and if the steel frames receive proper care which modern methods have put into our hands to be used and can be used, I think that the steel car is good for a much longer life than the wooden car. As to the power required to move these large cars, I think that with equal tonnage, a large-car train can be handled easier than small-car trains of similar tonnage. That is, after the train is in motion over an undulating grade, the resistance is less as the large cars cover less of curves, etc., but I do not think that in starting the train there is any gain. There are a number of interesting problems that have had to be solved since we commenced using these large cars, but nothing of insurmountable difficulty has been encountered, and I think that the service generally has been satisfactory.

Mr. F. A. Foque, Assistant Mechanical Superintendent, Soo Line: It has been my experience with metal trucks that after some months of service the rivets become loose and the various parts have to be taken to the shop to be re-riveted. I have found that to be the case both on locomotive tender trucks and freight cars. Corrosion should also be considered. Just a day or two ago I took from a car a pressed steel stake pocket that was merely a shell. Of course, we know that that pressed steel is thinner than is used nowadays in the construction of metal cars, but I see no reason why, with a few years added, we should not expect the same thing from the exposed portions of a metal car that we find now with the exposed stake pockets; which I think we can admit did not prove to be a success.

Mr. Seley: Of course, we all know that unprotected steel will very quickly corrode from moisture in the atmosphere and acids, and, as I said, we have a means at hand for taking care of that, if it will be used. We paint our cars with compressed air, which thoroughly drives the paint into the crevices where the brush would not take it. The frames, before any woodwork is applied, are very carefully painted with a red lead paint made from our own formula, and thoroughly applied. The lumber which is used on the car, which comes into contact with the steel frame, is either heavily coated with paint, or a product that we obtain in the South, called spiritine, and if these cars are looked after periodically, and cleaned and painted, I do not know of any reason why they should deteriorate in their members. I have had the same experience that Mr. Foque speaks of in regard to pressed steel stake pockets. They were taken off merely skeletons, but I think they were very thin in the first place, and probably rusted through from inside and outside. A stake pocket is more exposed than any other part of the car, and would naturally wear out faster in that respect.

As regards loose rivets, I think that is a matter of proper design. It shows conclusively, that if a rivet gets loose in a few months it has been over-strained or not properly proportioned. It has not been the practice on the Norfolk & Western to rivet truck columns to the spring plank before this 80,000-lb. car was designed, but there I have riveted the columns to the spring plank. Those cars have not been in service long enough for me to say whether I have got in rivets enough or not. But I believe from the test we have given them, that they will stay tight a long time, although, of course, the truck is subject to shocks that are very hard on rivets.

Mr. G. P. Zachritz, General Car Inspector, Soo Line: I have had little experience with steel car bodies and steel frames, but I have had considerable experience with steel trucks, mostly pressed steel. I have found quite a few of them that have loose rivets, and I have found quite a few of them cracked. I do not think this class of car is going to be economical. You take the refrigerator service, for instance. I find that the steel truck will soon rust out, and that the wooden truck is much better. Some steel cars have tubular framing, and I find a great many of these tubular sills cracked. The strain on them appears to be too much, and they crack, some of them forward of the transoms, and some back of the transoms.

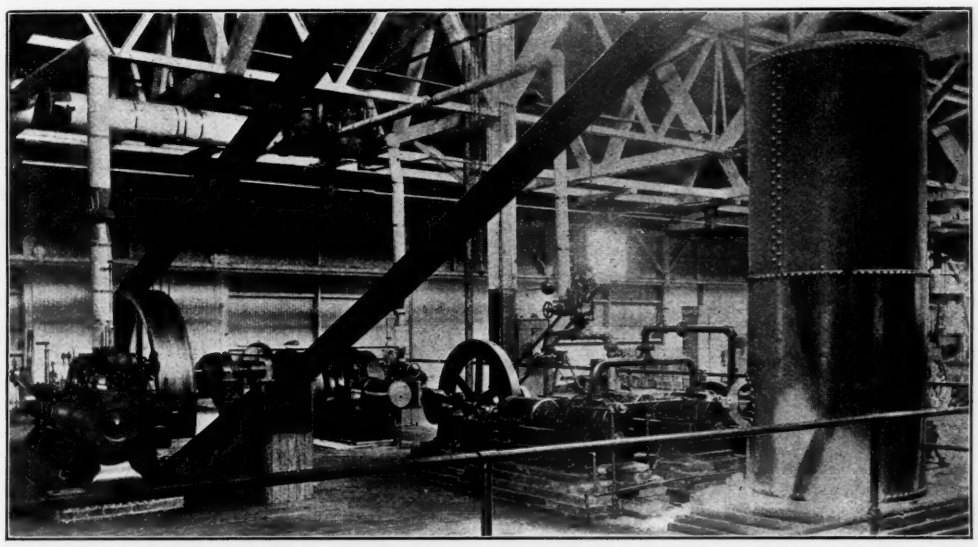
Mr. D. Van Alstine, Master Mechanic, Chicago Great Western: I think it is necessary in steel truck design to put in just as many rivets as you can get in where it is necessary to use any at all. It is advisable to do away with rivets entirely at all points possible, but where they are necessary, use an excess. If the holes are reamed and the riveting well done there is very little liability of rivets working loose. There is another thing I notice in connection with steel truck bolsters of either I-beams or channels. In designing them it is necessary to allow a high factor of safety. If the bolster is at all weak laterally, sooner or later the flanges will crack and spread and then the bolster comes down very rapidly, due to the vertical load.

The Swiss Parliament has voted the rates of pay of the different classes of employees of its State Railroad system, which will be turned over to the government in 1903. The lower classes of employees are much better satisfied with the scale than the higher officers, who are limited to salaries of $2,000 to $3,000, which is much less than some of them have been getting from the companies. The scale provides for nine classes of employees, and in the lowest class the wages vary from $240 to $440 per year. It is hardly probable that the State can keep the best officers at these salaries, especially the younger ones, who may find a career in other industrial enterprises.

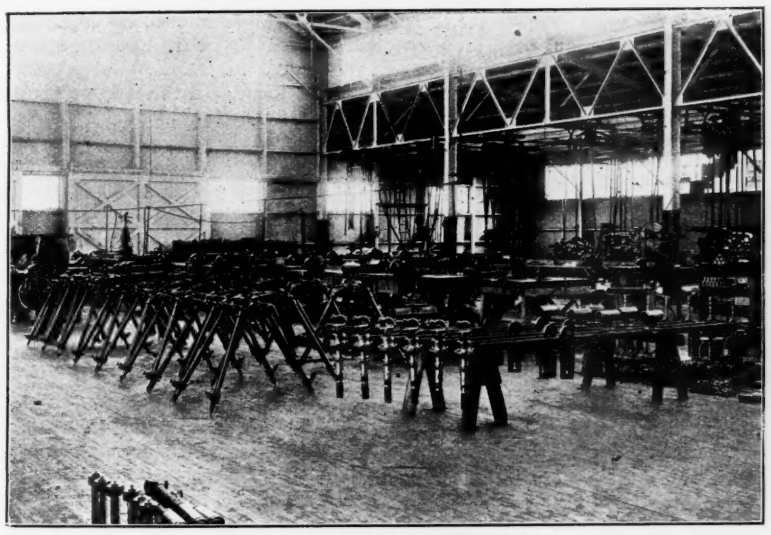
The Philadelphia Works of the Chicago Pneumatic Tool Co.

On March 1, the Chicago Pneumatic Tool Co. bought five acres, at Olney, a suburb of Philadelphia, on the Philadelphia & Reading Railroad. The property includes a main shop building of modern steel construction, 60 ft. x 300 ft., with a wing at either side 30 ft. wide, and various outbuildings of brick. The total floor space of the main building is 36,000 sq. ft. The property was put in order, and the plant was in full operation on May 1, carrying on the regular shop work of this company's air-tool manufacture, under the management of Mr. C. H. Haeseler and the name of the Philadelphia Works of the Chicago Pneumatic Tool Co. Illustrations herewith indicate the general interior arrangement of power and tools. There is liberal provision of light and air.

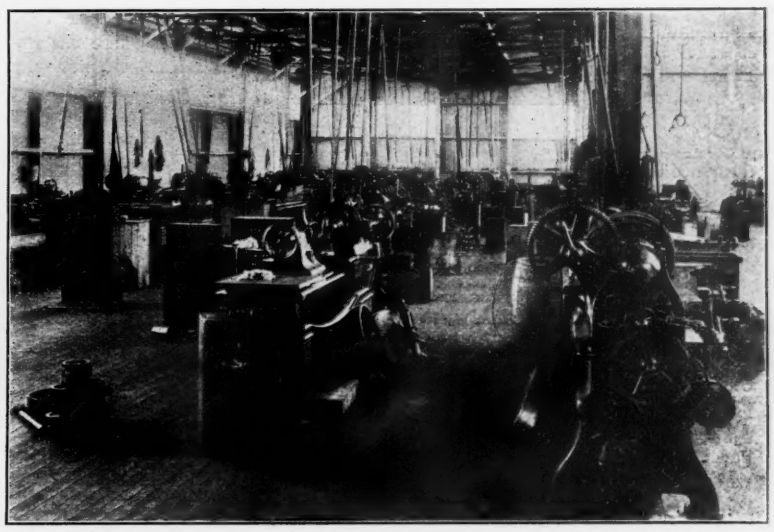
The shop has a capacity for 500 employees. The power plant consists of a battery of four 100 h.p. boilers. The main shop engine is a 100-h.p. Fitchburg, automatic cut-off. A 9-in. x 10-in. x 9 in. duplex, steam actuated, air compressor, manufactured by the New York Air Compressor Company, furnishes the compressed air for testing the tools. A 325-light Siemens-Halske dynamo, driven by a 75-h.p., Watertown, engine furnishes the light for the plant. The shops are heated by a hot air blower system installed by the Sturtevant Company. There are now being produced over 300 air machines a month. It may be noted from the photographs that the machine tools are grouped in each wing of the main shop, while the vise work and assembling are done in the middle of the shop. The tool room is situated in the center of the shop. A group of automatic machines is shown as a prominent part of the equipment. These machines never cease to be wonderful in their performance, as compared with the ordinary screw machine, or old-style engine lathe. It requires but one operator for five machines, and in one instance it is possible to turn out a piece of work in six minutes that requires a first-class mechanic two hours to accomplish on the ordinary engine lathe. A card system of record is used in the store room, cost department, drafting room and main office. This governs in a thoroughly systematic manner the receipt and shipment of all materials; records all finished parts and machines in stock; registers permanently the cost of producing work; tabulates the shop drawings; gives a symbol number to every part entering into the construction of the various machines; enables the men to correctly report their time each day; records the filing of letters and catalogues, and has proven to be an excellent system for governing such matters. The equipment of the plant throughout, and the arrangement of its various factors form a nice example of modern practice in light machine-tool making.



Power Plant.



Assembling Department.



Automatic Machines.

Views in the Philadelphia Works of the Chicago Pneumatic Tool Co.

Eyes and Headlights.

Let a man be whatever else he may if he lack normal vision his ambition to run a locomotive is hopeless. Thanks to the persistent agitation of the enthusiasts of 25 years ago, who sometimes were even looked upon as cranks, reputable railroad officers no longer wink at the appointment of men whose deficiencies of sight will always be a hindrance to them in their work. We have witnessed pathetic scenes where faithful and intelligent men were rejected as aspirant engineers because, as firemen, defective sight had come upon them. We have especially in mind one young man who at the end of seven hard years came up for final examination, only to learn that his sight was imperfect; that he must not only fail of promotion, but must give up his place as fireman, and, if so fortunate, go back into the roundhouse as hostler or wiper. This ruling is just and reasonable, and the case is simply one of many. It is specifically mentioned that the value of clear vision may be emphasized, and also that the conditions met by more fortunate candidates for the engine cab may be noted.

Assume that a man passes a necessarily exacting examination. He is assigned to the night trick on a yard engine where, for some months, he sets his teeth and takes chances in a darkness which is broken by just light enough to keep him constantly wishing that he could see more distinctly. His evolution presently takes him out on the line with a freight engine. There he sees all right during the day, but (if it be winter) in the greater part of the twenty-four hours, with the assistance of the average headlight, his carefully examined eyes can penetrate the darkness ahead and define the track only for about four engine lengths. This condition on a freight train, in his early experience, is first ruinous to the eyes and later quite conducive to sleep. Since he cannot see far enough to forestall more than one out of a hundred of the dangers that may beset him he soon learns to take chances, and also learns where best to catch forty winks on duty, or, as he might say to you if you knew him well, "maybe forty-one." If he is fortunate, and nobody else makes a mistake, he never comes to grief; but that is not because he always saw a clear track. In due time he gets a passenger run, more likely night than day, and he sits behind the same sort of headlight, giving him at most a sight value of from three to ten seconds in which to make up his mind and act at speeds of 60 miles an hour or less. These conditions as to the range of sight are strangely incongruous as measured by the requirements which the man's eyes have previously been obliged to meet. It is a strange paradox that we so carefully test the sight of him who is so often to go blindfolded where he well might see.

There have been numerous discussions as to whether the headlight should be regarded as a night substitute for daylight on the track, or simply as a "marker" of an on-coming train. One night in the cab of an overland express engine will go far toward convincing anybody that the only light desirable ahead of a locomotive is the best one that can be had, and that the ordinary headlight is literally but a marker of its own shortcomings. Those who know the conditions only superficially must wonder that the locomotive should so long have retained a piece of primitive equipment which is tacitly admitted to be doing its most effective duty when occasionally borrowed to illuminate the restricted circle of a country bush-meeting. Basing opinion upon observations taken during many nights at the cab window, both in thickly peopled districts and in the desolation of the plains and mountains, the writer holds that a locomotive should be equipped with the most powerful headlight obtainable, before it is permitted to be used on the main track of any railroad. In the present stage of development this means the use of the electric headlight. Its cost is more than that of an oil lamp, both for installation and for maintenance, but it may be a cheap way of preventing wrecks from many causes, and the amelioration of the strain on the enginemen's nerves, which, from all testimony, appears to be an admitted benefit everywhere that electric headlights are used, is not a small advantage.

But in spite of the great need of a good light a chief argument against the use of powerful arc headlights is that signal lights ahead are dimmed by the headlight's intensity. This contention is based upon no material foundation, as has been demonstrated quite thoroughly. The effect of an electric headlight upon a field of signal colors is to intensify the individual signals. Coming down upon a railroad yard at night the effect, to the man behind the headlight, is quite like that of looking upon a field of rain-washed lenses after a drenching night shower has fallen. The reason for this is plain. The convex lens of a switch lamp, for example—let it be red, green or white—darkens toward its rim. Its most brilliant point is directly at the center, if the lamp within is properly focused. This being true, set in a field of black, as at night, each color field tends to merge into the darkness, and the perceptible color area is thus lessened in proportion to the distance of view. Bathed in a white light not more intense than that of the electric headlight, every color area is set upon a modified screen of white, its deepest shade is readily outlined, and near it are clearly defined objects of various color-tones that lend added value by contrast. Thus it is true that instead of dimming switch lights, as has been contended by some, the colors are made more easily distinguishable. This holds true down to the very moment of passing them, and in that moment the colors of the day signal (say a flag, assuming that it is a tail light) are distinctly shown.

The value of a strong headlight is not to be gaged from one point of view only. The temptation to sleep is much reduced when behind a bar of light as strong as that of the electric headlight. To sleep in the face of one coming toward you is well-nigh impossible. Its projection of light above the hill line of curves, and on a hillside or meadow to the side of them, is so "loud" an effect—to use an artist's term—that it never fails to attract attention, and on a single track line must give earlier warning of impending collision than is now generally possible. Several instances are recorded where this sight of an opposing headlight has directly averted

(*Continued on page 674.*)

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The Prairie type freight locomotives of the Chicago, Burlington & Quincy have now been in service about six months, and are a success. They have not only met the expectations of the designers and builders, but that road has probably never had a new design of locomotive which has met with so little adverse criticism. The essential features of the design have already been adopted by other roads that have apparently anticipated favorable reports of performance, and the Burlington itself is now preparing to order twenty or thirty more Prairie type engines. These will weigh about 150,000 pounds, have 20 in. by 24 in. cylinders, and boilers 68 in. in diameter at the front. Of course, in these it is desired to correct any faults in the first design, but although the performance has been watched closely, it has been really difficult to find where improvements can be made. The new engines will probably be a little larger, but essentially the same as the first, which means a good deal, as this design involved many new features. The six months' experience has confirmed Mr. Delano's opinion that the wide, deep fire-box is the proper one for burning bituminous coal, and the present records of the new engines indicate at least 15 per cent. economy over other engines running in the same pool; no attempt has been made to favor the new engines. It seems quite clear, also, that coal can be burned with these engines, making steam freely, which cannot be used with narrow fire-box engines. One of the Prairie type engines used on the Burlington & Missouri River is now running with fair success on lignite coal, and it is thought that if it is found impracticable to burn clear lignite, at least half lignite can be used. The use of inferor grades of coal is doubtless one of the most important results attained with wide, deep fire-boxes, and offers the greatest opportunity for saving.

Attention is called to the account of recent tests of Westinghouse friction draft gear in another part of this issue. It is the most striking thing that has yet been published on draft rigging. In fact, it will be amazing to any one who is not familiar with the theory of the friction draft gear, and who has not seen it actually at work. To us, having watched the development of this apparatus for years, the results of this Wilmerding test are not unexpected, but still astonishing. While it has a certain meaning to say that the capacity of the friction gear is seven times a single spring arrangement, or from three to four times a rigging with double springs, yet that does not appeal to one like the actual results of such a service test as this. It cannot; the imagination is too dull. But we at once appreciate the importance of the fact that it was not possible to break a long train in two under such severe conditions, and this shows in a convincing way the ample capacity of the friction gear and the effectual manner in which the recoil of the springs is prevented. We have no doubt that the direct recoil from springs of 140,000 pounds capacity would destroy any attachments that could be put on a car. Railroads are beginning to appreciate the need of better draft rigging, but they are reluctant to pay the greater first cost of draft attachments suitable for heavy trains and high speeds. There is also reluctance to acknowledge that there is serious trouble from break-in-twos, but it is generally known that such troubles are increasing. At the recent meeting of the Traveling Engineers' Association, an instance was cited where a train in going a hundred miles broke in two no less than thirty-two times, and the trouble is general and not confined to any particular road. Enginemen, air-brakes and couplers are being condemned when the fault is largely because the draft attachments will not do several times the work they were designed for. Of course, these things are bound to adjust themselves in time, but now it seems a short-sighted policy to equip new cars with draft gear of half the capacity of heavy locomotives, when such rigging cannot stand the shocks of very ordinary service.

The right to reserve your seat in a day passenger car was discussed the other day in the New York *Sun* by a veteran railroad lawyer, and we copy his words in another column. His views are obvious common sense, and probably common law, and yet the question will probably not get settled in this suit. Take the matter of a double seat, as the editor of the *Sun* pertinently remarks, the question whether this man Smith was trying to keep one seat or two may have a deciding effect in settling his case. The fact that all seats are double has thwarted justice a thousand times; for one does not often care to enforce the law, or his personal rights, by sitting for an hour in the seat with the person who is being punished. One feels too much like a constable handcuffed to a thief. Another fact which causes Justice many tears is the lack of grit in conductors. She must often think that she has a pretty weak-kneed staff in these gentlemen. If we only could have an example now and then of the old-school conductor, who stood up for decent passengers, even if occasionally he had to stand *on* the hoggish kind, it would be salutary for many of the latter who are still alive. Another question concerning seats which often occurs is this: Where has the passenger gone? Perhaps he is not after a newspaper, but is taking a half hour's smoke in the smoker. Has he a right to two seats? Does the railroad intend to furnish that number for him? If so, why not give a woman a seat for her bird cage or lap dog? Sleeping cars do furnish duplicate seats; the smoking room is for the benefit of smokers who have seats in the main body of the car also. On some few "crack" trains (not wholly made up of sleeping cars), two smoking cars are run, one for smokers of Havana cigars and the other for stogies. This indicates a purpose to be liberal with smokers. But how about a crowded train? If an unexpected rush fills every car, should not the smoker forego his implied right to two seats? As this right has never been specifically granted to him, the conductor should be free to give the empty seat to a non-smoker, should he not? Here, again, we find the need of conductors of some courage, discretion and sense of duty to passengers.

We have heretofore called attention to the fact that in the development of the electric railroad, history is repeating itself. In various features of this new art we see manifestations quite similar to those which were observed in steam railroad life 60 or 70 years ago. The men who are making electric railroad history begin, *de novo*, as though they had just come out of the woods, learning nothing from the experience of other men with cars and rails and grades and brakes on thousands of miles of railroad. The latest example of this way of learning to "railroad" comes from West Chester, Pa. Between that place and Philadelphia the other day two motormen met on single track some distance from a side track, and after quarreling over the right to the road, the one who had the advantage of a down grade bumped his car violently into the other, and 20 passengers were injured. The hundred or more passengers, at first mildly entertained by the dispute between the crews, became intensely indignant after the collision, and threatened corporal punishment then and there, but finally were restrained. The conductors as well as the motormen took part of course. After the collision the culpable motorman put the blame on his conductor, who, he said, had started the car by letting off the air-brake from the rear platform. We say this is a repetition of history. It is slightly intensified, however. We do not recall any such realistic encounters with passenger trains, even in the most primitive days of the railroad, though it is quite possible that such cases may be within the memory of men older than ourselves. In the freight service, however, this kind of barbarism was by no means uncommon, and many of our readers will, doubtless, recollect more than one instance. In the railroad service this lack of civilization was due to the fact that the superintendents had not got their bearings. They had not fully learned their business, and where they had, each one had many more details than he could attend to. No master being at hand, the enginemen bossed conductors, and ran as they pleased. Meeting half way between side tracks was common in level country, for with wideawake and fair-minded conductors and enginemen and with the somewhat imperfect despatching arrangements of those days, time was often saved by allowing the practice. But superintendents gradually learned to stop such loose practice, and some of them, who are still living, now wonder that they ever allowed it. They will wonder still more when they see that it is now necessary to learn such plain lessons over again.

Life of Steel Cars and Tenders.

It is estimated by some that the life of steel cars as now built will be at least 20 years under ordinary conditions of service, whereas a certain French road expects to get from 50 to 60 years of service from small four-wheel metal cars when the painting is properly attended to. This latter estimate, by the way, is based upon a study of the condition of cars after thirty years of service. On the other hand, a few roads in placing orders have shown a preference for cars with steel underframes and wooden superstructure, fearing rapid corrosion of the metal parts if brought in contact with the lading.

As it has been suggested that the corrosion of metal underframes and tank plates of locomotive tenders should indicate what may be expected to happen with all-steel cars under very severe conditions, we have got information regarding the life of locomotive tenders from several of the principal roads, and this shows a pretty uniform experience. It is learned that, in addition to corrosion, the life of tanks is affected by the kind of water carried, the thickness of the plates and the bracing of the sheets. Side and back sheets, 3-16 and ¼ in. thick, and which are always well painted outside, are variously reported to last from 15 to 25 years. They usually fail first by cracking along the lower row of rivets, and the life of these sheets depends chiefly on how well they are braced to resist the forces set up by the surging of the water in the tank. Bottom tank sheets, ¼ in. thick, and resting on the frames, are generally said to last from 10 to 15 years, in which case they fail by corrosion; but one road reports from 5 to 7 years, failure being due in that case to the fastenings becoming loose, so that the bottom plates wear by working on the frames. The top tank sheet, ¼ in. thick, is often in contact with the wet coal, and is also used as a place to store tool boxes, coupling links, etc., which tend to wear the plates. One road states that top sheets have to be renewed in from three to five years, while others generally agree on from eight to ten years, this sheet failing by corrosion on the outside. The life of ¼-in. plates surrounding the coal space is variously given as short as three and as long as 12 years, but an average would appear to be from six to eight years. The side plates tend to bend along a line near the bottom, and possibly this action hastens corrosion. The first failures occur near the bottom of the side sheets, and the corrosion is on the side next the coal space. These plates seem to be little affected by corrosion on the water side. Metal underframes made of channels are estimated to last from 25 to 30 years under ordinary service conditions, and several state that the frames are cleaned and painted each time the locomotive undergoes general repairs. Wooden tender frames are said to last seven and eight years.

The experience with small metal cars on the Eastern Railroad of France, previously referred to, would lead to conclusions quite different from any that might be drawn from what we have gathered from the life of tenders. The condition of different kinds of metal coal and coke cars was investigated in 1896 by Mr. L. Tolmer, and reported that year at length in the *Revue Générale* for May. Metal car construction was adopted by the Eastern Railroad in 1861, so that the cars examined had been in service from 20 to 40 years. They vary in length from about 16 to 23 ft., have two axles and a capacity of about 10 tons. It is plain that more attention is given to

painting and repairing cars, and the service is much less severe than in this country, as is evidenced by the statement that wooden coal and coke cars in France have a life of from 30 to 40 years. The loss by corrosion of the steel cars was obtained by taking apart cars of the several kinds and comparing the weights and sections of the members with the weights and sizes when new.

Cars 34 years old, having the upperframe work alone of metal, are first mentioned. The metal upperframes had lost 6.04 per cent. by weight, and as the corrosion occurred at points where it greatly affected the strength, the iron work then required renewal to keep the cars in service, and such construction is not favored.

When the cars with combination metal and wood underframes and metal upperframes were examined, they were 30 years old. The I-beam sills had lost 3.35 per cent. of the original weight chiefly from the inner surfaces, and surfaces so covered by other parts that they were seldom painted. The strength of the sills was not seriously affected. The metal upperframes lost 4.32 per cent., the greatest corrosion being where metal was inside the box or where it was covered by wood. The gusset plates joining the end and longitudinal sills had to be replaced repeatedly, and about 15 per cent. of the rivets were in doubtful condition. It was thought these iron sills would show a life of 50 or 60 years, and the metal upperframe 45 to 50 years with slight renewals.

Cars with iron underframes and iron upperframes had been in service 20 and 26 years when inspected. The underframes of the first class had lost 3.18 per cent. in weight, and the second lost 6 per cent. The loss of weight from the upperframes on cars 20 years in service was 5 per cent. The 5-16-in. gusset plates lost 18 per cent., and had to be renewed. The metal of the framing inside the box and that covered by other parts showed the greatest corrosion. With slight renewals these cars were expected to give 50 years' service.

Cars with underframes, upperframes and sides and ends of metal were 21 years old when examined. The underframes had lost about 4 per cent., the iron side and end plates only 1.8 per cent., but the framing of the box which was of light sections and covered by the plates had lost 12.5 per cent. The excessive loss of weight in the upperframing when iron side plates were used, compared to that when the sides and ends were wood, is accounted for by the fact that the wooden parts have to be renewed at rather frequent intervals, affording an opportunity to clean and paint the framing. It was thought that the iron upperframe of such cars would require renewal at the end of 20 years, and also that 35 per cent. of the rivets having heads on the inside of the box would have to be replaced each time the cars underwent heavy repairs.

From this short summary of the results of Mr. Tolmer's study, it appears that the plates forming the sides of the box are not so subject to corrosion as experience with locomotive tenders in this country indicates, and further that the life of those metal cars is about double that of wooden cars. He also points out the importance of painting metal cars about once every three years; of using machine driven rivets which fill the holes better than hand rivets, and of using heavy sections in framing the superstructure.

As stated before, what is said here cannot be considered conclusive. The life of steel plates used in cars may be longer than when used on locomotive tenders, and, on the other hand, the French cars are so much smaller and subject to so much lighter service that their performance may or may not be of much value in this country.

So far as they go, however, Mr. Tolmer's investigations are very encouraging as to the future of the all-steel car.

Annual Reports.

Reading Company.—Under the last reorganization of the Philadelphia & Reading properties in 1896, their control was divided among three distinct companies, each with a separate field of operations. These are the Philadelphia & Reading Railway, the Philadelphia & Reading Coal & Iron Company and the Reading Company. The latter owns substantially all the stock of the two former companies, and the equipment of the railroad, except that bought since the reorganization; and as its bonds and stock are those held by the public, the annual report is issued in its name. Practically however, except in the financial tables, the statement for the June 30 year now at hand is given up to a recital of the business of the railroad company. The record is of prosperity and although (as with so many other companies) the larger share of the increase in revenue has been turned back into the property for improvements and facilities, a surplus of $1,938,000 is shown for the year as against $1,165,209 in 1899, and $1,376,000 in 1898. The earnings of the Coal & Iron Company, and those of the railroad company from coal, merchandise, passengers and miscellaneous business, were larger as to each class and in gross than in any preceding year.

It is interesting to note, however, that the Philadelphia & Reading, like the New Jersey Central and other of the so-called anthracite coal carrying lines, is gaining faster in the development of general business than in coal traffic itself. If the present relative ratios of increase in these classes of business on the Reading are maintained, it should soon earn more revenue from general freight than from coal. Of the total gain of $3,900,400 in railroad gross receipts last year, merchandise business yielded $1,925,700, a gain of 25 per cent. in that revenue, while coal tonnage yielded $1,285,500 of the additional revenue, being a gain of 13 per cent., and if the comparisons are carried further back, the growing diversity of business is still more clearly brought out. Details of the traffic movement for the last three years follow, with the revenue from the different classes of traffic.

	1900.	1899.	1898.
Coal revenue	$11,371,203	$10,085,701	$9,931,896
Merchandise revenue	9,750,602	7,824,888	7,163,170
Total railroad revenue	26,109,734	22,456,193	21,475,242
	Tons.	*Tons.*	*Tons.*
Tons merchandise	14,192,019	11,385,928	9,862,641
Tons anthracite coal	10,672,556	9,533,693	9,464,598
Tons bituminous coal	4,539,719	4,201,622	3,517,069
Passengers carried	21,910,349	19,689,787	18,671,433

As compared with last year tons of anthracite coal increased 12 per cent., of bituminous coal 8 per cent., against 19½ per cent. in the preceding year, and the revenue from these two classes of freight increased 12⅜ per cent. Merchandise traffic and revenue each increased 25 per cent., while the number of passengers carried was 11⅓ per cent. greater than in the preceding year, and the revenue derived over 10½ per cent. larger.

This development of the Reading as a line of general traffic has forced the management to face special problems in preparing the road to move its new business expeditiously and economically. The whole system in large part has had to be rearranged and divisions and branches of secondary importance, when the energies of the management were chiefly devoted to the coal business, have had to be developed and rebuilt to form parts of new routes for the better handling of merchandise. A great part of the present report, as of the two immediately preceding statements, is devoted to the recital on the improvements and new facilities provided, chiefly out of current income. Extensions of track, including second track, passing sidings, factory sidings, etc., and terminal tracks and new yards have been carried out on an elaborate scale.

Some of the work may be mentioned in detail briefly. With the completion of about five miles of double track now building the company will have a continuous section of double track line from Philadelphia to East Mahanoy Junction, a distance of 104 miles, and on the Lebanon Valley division the building of nine miles of new double track will form a continuous double track from Reading to Harrisburg. The total expenditures for new tracks has been $797,521. The equipment of the line with automatic electric signals was completed on about 45 miles of line between Philadelphia and Bound Brook, and at such points on the main line from Philadelphia to Pottsville as were not previously equipped, the sum of $294,600 having been expended for signals in the past year. In the last six years, the report points out, $553,000 has been spent for new signals and the company now has the equivalent of 477 miles of single track protected by automatic signals. This year further extensions are to be made, carrying the signals to Bethlehem, 32 miles, and to Harrisburg, 56 miles.

Such work as this, together with the reconstruction and replacement of equipment, accounts for heavy increase in yearly expenses, this having been last year $3,373,000, with an enhancement in earnings of $3,900,000. The same policy of improvement, however, has been pursued with the Coal Company.

The total revenue of the whole Reading system was $55,946,000, against $46,883,000 a year ago, and the net earnings ahead of fixed charges and taxes were $11,088,500, as compared with $10,239,100. The inter-relations of the three companies and the duplication of accounts make it difficult to clearly set forth the net results. As given, however, in the income account of the Reading Company, the year's surplus was $1,938,000, out of which there was paid a sinking fund charge of $383,525, being 5 cents a ton upon all coal mined from the Philadelphia & Reading Coal Company's lands. There was also paid a dividend of 1½ per cent. on the Reading Company's first preferred shares, calling for $374,735, the payment of the sinking fund charge above named and it application toward reducing the outstanding bonds is required by the reorganization plan before the payment of each dividend. In addition, last year the Coal and Iron Company was charged with a sinking fund of $750,154, being 5 cents a ton on over 15,000,000 tons of coal mined from its land since July 1, 1898, while it turned over $884,850 to the Reading Company, being 1⅛ per cent. interest on its debt to that corporation, which is payable only when earned, this being done for the first time last year.

New York, New Haven & Hartford.—In the fiscal year just closed the earnings of this company from freight for the first time exceeded earnings from passenger business, and both freight and passenger earnings were the largest in the history of the company; that is, the earnings from the passenger department were 19¾ millions, and from the freight department 20.2 millions. The ton-miles amounted to 1,340¾ millions, which traffic was carried at the comfortable figure per ton per mile of 1.45 cents. Of course, it will be remembered that in the territory of this company the haul is short, namely, 85.36 miles, and the proportion of high class freight carried is large. We have recently had something to say of the arrangements lately made by the company for the better accommodation of its freight business, and have particularly described the Oak Point yard. In looking over the annual report we find numerous items of expenditure for freight stations and freight yards.

The gross earnings from freight per mile of road have now reached the handsome figure of $9,923, or $2,900 more than the total gross earnings per mile of road of the average railroad of the United States. The earnings per mile from passengers amounted to $9,726; that is, the total receipts per mile of road worked were $19,844.

The gross earnings of the company from operation amounted to $40,325,152 and the operating expenses were $28,224,840. The income from operation, plus income from other sources, less taxes and interest, left a balance of $4,622,614 available for dividends, and out of this 8 per cent. was paid, leaving a surplus of $391,336.

While the gross earnings from operation increased 8½ per cent., the working expenses increased 10½ per cent., but this item includes the sum of 2¾ million dollars charged to working expenses and spent for betterments and new equipment. If this charge had not been made, or had been made to some other account, the working expenses would have been less than in the year before by 1.24 per cent.; but in fact no charges to capital account were made during the year excepting $365,000 for real estate. In the charges to working expenses we find 40 locomotives, 500 coal cars and new equipment for the Bay State limited trains, aggregating something over $1,000,000. We find $462,000 spent for taking out grade crossings and $227,000 spent on Bridgeport improvements. Charged to working expenses are also electric motors and cars and other electrical apparatus and a power house, all of which might very properly have been charged to capital account under another policy. In the same account we find also numerous items of improvement of passenger and freight yards and stations, but, of course, our readers are familiar with the policy of the company in these particulars for some years past.

It is expected that about half the work of abolishing grade crossings in Bridgeport will be completed and the tracks in use by the first of next year. The remainder of the work will be continued as fast as legal obstructions are removed. Legislative acts providing for the abolition of grade crossings at Fall River and Worcester will necessitate early action and considerable expenditure. There is to be an enlargement and consolidation of shops. All of the engine work for the Eastern District will be concentrated at Norwood, and all the car repair work will be concentrated at Readville. The electrical installation on the Providence, Warren & Bristol Railroad is nearly finished, it having been delayed on account of slow delivery of equipment and machinery.

Erie Railroad Company.—Perhaps the point of greatest interest in the fifth annual report of the reorganized Erie Railroad Company is in the showing made in the capacity of that company to produce transportation at low cost. As we are all now very well aware, the vital element in the prosperity, and indeed in the continued existence of a great railroad company of to-day, is the capacity to handle a large volume of traffic at a small profit per unit. This is the point which more than any other is emphasized in the annual reports which are now coming before us, and in this particular the Erie report is especially interesting.

In the year just closed that company handled 5,157,955,975 ton-miles of freight, the increase over the year before having been 6.68 per cent. The passenger miles increased 8.83 per cent. and aggregated 446,190,767. And yet, among the items of working expenses, we find that conducting transportation increased only 3.95 per cent., and more than one-half of this increase was in the one item of locomotive fuel. This result was brought about mostly by heavier loads. The average revenue freight trainload in the year under review was 369 tons, an increase of 16.6 per cent. over the year before. If we include company's material the average freight trainload was 392.32 tons. The average load per car was 16.73 tons, the increase having been 6.02 per cent. It follows that with the greater volume of traffic the freight train miles actually fell 8.51 per cent., aggregating 13,978,134, and the freight car miles increased only one-fourth of 1 per cent. The greater passenger movement was also handled with an actual decrease in passenger train miles, this decrease having been 0.86 per cent. As a result of these heavier loads we find not only a reduction in the item of conducting transportation per traffic unit, but we find that the earnings per freight train mile rose from $1.637 to $2.062, and the earnings per passenger train mile increased from $1.439 to $1.734. Of course these earnings are affected by the better rates as well as by the better loading. The average freight rate was 5.59 mills instead of 5.17 the year before, and the average passenger rate was 1.55 cent instead of 1.44. The rate on coal, by the way, was 4.57 mills, which is more than twice the coal rate on the Chesapeake & Ohio. The average freight rate on the New York Central in the fiscal year just ended was 5.6 mills and that of the Pennsylvania in the last

year reported on (1899) 4.73 mills; doubtless it has been higher this year.

The Erie's average cost of carrying freight was 4.27 mills, an increase of 0.3 mill per ton per mile. A considerable item in this increase was the heavy expenditure for improvements and betterments charged to working expenses, concerning which something will be said later on. In dividing the increase in freight revenues the sum of $1,806,580 is attributed to increase in tonnage and $2,011,985 to increase in average rate.

In the division of working expenses we find that there was an increase of more than $900,000, or 29.28 per cent. in the item of maintenance of way and structures as compared with the year before, the aggregate having been $3,974,618. The work of replacing light bridges has been carried on and during the year $90,000 was charged to working expenses for the renewal of the Kinzua Viaduct alone. Of company's sidings 38.2 miles was built, of which less than one-third was charged to construction account. Thirteen and one-half miles of private side tracks was also built and largely charged to working expenses. The 90-lb. rail laid amounted to 18,119 tons and the 80-lb. to 6,183 tons. A good deal of ballasting was done, nearly a million ties were put in and 620,000 tie plates.

Maintenance of equipment, which amounted to $6,889,647, increased 33.16 per cent. over the preceding year. This was due to the purchase of heavier equipment, the remodeling of lighter engines and cars and the application of air-brakes and couplers. The company bought or built 20 locomotives during the year which were charged to maintenance account, and about 50 which were charged to capital account. A little over 1,500 freight service cars of various sorts were bought or built and 784 were rebuilt and the sides of 3,574 coal cars were raised, all of this being charged to working expenses, while capital account is charged with 1,000 steel hopper coal and ore cars of 100,000 lbs. capacity, six horse express cars, a rotary snow plow and a 50-ton wrecking crane. The company also charged to working expenses $424,000 for equipping stock with M. C. B. couplers and air-brakes, the law being now quite complied with in this respect. Since Dec. 1, 1895, the company has expended $8,081,583 for new equipment.

The principal results of operation are as below:

Earnings.

	1899.	1900.
Freight	$17,817,941.76	$20,152,762.44
Coal	7,191,481.83	8,675,226.09
Passenger	6,310,443.87	6,905,224.28
Mail	486,019.74	492,171.45
Express	592,612.97	616,029.57
Rents	131,108.84	120,985.77
Miscellaneous	1,223,094.91	1,330,632.27
Total earnings	$33,752,703.92	$38,293,031.87

Expenses.

Maintenance of way and structures	$3,074,317.45	$3,974,618.01
Maintenance of equipment	5,174,136.80	6,889,647.42
Conducting transportation	15,204,801.54	15,806,021.02
General expenses	725,739.00	780,795.75
Taxes	990,931.49	997,522.94
Total expenses	$25,169,926.28	$28,448,605.14
Net earnings from operation	$8,582,777.64	$9,844,426.73

To net earnings from operation should be added income from securities, etc., making a total income of $10,264,535. Interest and rentals being paid out of this leave a balance to profit and loss of $1,663,430. This surplus added to that of the previous three years and seven months gives a total surplus earned from Dec. 1, 1895, the date of the company's organization, of $3,454,874. Of this accumulated surplus a quarter of a million dollars has been advanced to the Chicago & Erie, a third of a million on account of old New York, Lake Erie & Western car trusts, about $320,000 to the New York & Greenwood Lake for construction purposes; invested in materials in excess of the amount received from the receivers nearly another million dollars and finally over a million and a half expended for construction, car trust payments, etc. The company has received cash from all sources for construction and equipment since December, 1895, about 10¾ million dollars, and has expended in addition to this $1,155,000, for which it is entitled to be reimbursed from the sale of prior lien or general lien bonds.

Long Island Railroad.—The gross earnings of the Long Island Railroad for the year ending June 30 amounted to $4,557,259, and the net earnings were $1,281,186. After paying interest and rentals the net income was $159,493, from which $100,000 was transferred to the reserve fund, leaving $59,493 to profit and loss. The passenger earnings were the largest in the history of the road. While the gross earnings from all traffic show a decrease of a little more than $65,000 it must be remembered that the extraordinary revenue from Government business the year before amounted to $157,000. Thus the increase of gross earnings from ordinary traffic was $91,784. The passenger and freight earnings have increased steadily for four years. Since 1897 the increase in passenger earnings has been 14 per cent., which has been accomplished with an increase of 30 per cent. in passenger train mileage. Obviously, it has been necessary to give greater facilities to encourage the growth of this business, which doubtless is a wise policy. On the other hand, an increase of 11 per cent. in freight earnings in the same period has been brought around with actually a less freight train mileage. The total charges to capital account on account of additions and betterments to property amounted in the year to $219,776. The increased cost of material and supplies made it impolitic to undertake any new work chargeable to working expenses.

Relays for Automatic Signals—A Decision.

In the United States Circuit Court at Pittsburgh last week (Oct. 5) Judge Buffington delivered an opinion in the suit of the Hall Signal Company against the Union Switch & Signal Company for infringement of the Buchanan patent on relays for automatic electric signals, deciding in favor of the Hall Company. The decision appears to practically sustain the patent in all its essential features.

The complaint, entered at the May term, 1894, charges infringement of patent No. 497,489, of May 16, 1893. The patentee, John P. Buchanan, assigned his patent to the Union Switch & Signal Company. The object of the patent is to provide a shunt circuit by which an automatic signal is prevented from remaining fixed in the all-clear position in case the contact points in the track relay are fused by lightning. The relay of the Union Company containing this feature was described in the *Railroad Gazette* of March 30 last. As described in the patent, the arrangement of armature levers is vertical instead of horizontal, as in our description, and instead of a single lever, with an auxiliary pivot and fulcrum, there are two separate levers. The lever which is attracted to or withdrawn from the cores of the track relay is hung in a vertical position, pivoted at its top; when attracted, instead of directly closing the signal circuit, it presses, through an insulated block, against the upper end of another lever, pivoted at its lower end, and this second lever closes the local or signal circuit by a contact point fixed to its opposite side. If this point becomes fused to the one which it touches, thus permanently closing the local circuit, the first or armature lever continues free, as it is completely insulated from the second lever, through which the local circuit flows. On the entrance, then, of a train into the block section, de-energizing the track relay, the armature lever is retracted (by a spring) the same as under normal conditions; and on striking its back contact it makes a short connection between the two poles of the local battery, thus de-energizing the signal magnet and allowing the signal to go to the stop position. Thus the normal setting and releasing of the signal may go on repeatedly the same as before the contact points of the local circuit were fused.

The principal claim of the patent is based on the provision to control two or more pairs of contact points, so that when all the pairs are in one position a normal path is provided for the current, while if either pair is in the other position the current is excluded from its normal path. The principal claim of the defendant appears to have been that the same device was already in use; and a shunt circuit, used in duplex telegraphy, was brought in evidence. The Court holds that the prior patents cited in evidence do not show the essential features of Buchanan's invention; that the alleged resemblances are fanciful and not substantial; and that the shunt circuit in the duplex telegraph is not expected to work through an electrical storm, as if fused by lightning it is at once replaced. Instead of providing for the use of the shunt for an indefinite time the aim is to use it as little as possible. While in both devices a shunt current is used, the objects to be attained are wholly different. In the telegraph the permanent maintenance of the shunt current would suspend the practical working of the mechanism, while in the signal apparatus its effect is to make possible the continued working of the signal. The wide divergence between the two devices in form, object and operation is evidence that the change from one to the other was more than mechanical improvement. Neither one of the devices would suggest the other.

It was claimed that the invention in question was the joint work of Scott and Buchanan, though the patent was issued to Buchanan alone. This point is held not proved. A decree is issued in accordance with the finding, declaring infringement of all the claims except the tenth. The text of the decision, with a diagram, will be found in full in the advertising pages.

Prof. L. H. Bailey, of Cornell University, is preparing a Cyclopedia of American Horticulture, and it is proposed to include an elaborate article on "Railroad Gardening." He wishes to get as complete a list as possible of railroads that have done ornamental, economic or protective planting. From these roads is wanted a sketch, with dates, giving the plan employed in carrying on the work, the amount and character of the planting, and other information of interest. Roads which are now giving, or have at any time in the past given, attention to this subject are requested to send information to Mrs. Frances C. Seavey, Brighton, Ill., who has charge of this part of the book. The chapter to be prepared will contain information as to planting for such purposes as protecting banks also. In this connection we note an item from a Chicago paper of recent date to the effect that the Chicago & Northwestern is going to plant fewer flowers and more shrubbery. It seems to us that this is a commendable change. The Boston & Albany, one of the oldest railroad arboriculturists, has very few flowers. An important desideratum in adorning the grounds of a station is to have them look well throughout the year; and under circumstances as they are at present, another is to beautify as many stations as possible. No railroad, as yet, has done away with ugliness at all its stations; and as long as this is the case economical expenditure of money and labor is important. As flowers require much more care, for the benefit of their presence for a few months, than shrubs and grass do for eight, ten or 12 months, the latter are far less costly in the long run. With shrubs a high standard is easily maintained; with flowers a lower standard is maintained only by great care and effort; or, if excellence is maintained the temptation is to confine attention to a few stations. It is said that the Chicago & Northwestern will continue its greenhouses for the purpose of supplying flowers for the tables of its dining cars.

Demurrage bureaus, for securing the prompt unloading of freight cars are still a comparatively new institution; yet it is more than a dozen years since the first one was started and there is much truth in the claim made by the demurrage managers that the railroads have been saved hundreds of thousands of dollars by the work of these bureaus. We are reminded of this by the annual report of the Baltimore & Washington Car Service Association, just issued, for the year ending August 31, in which a statement is printed showing the total results of the work of that association for 10 years. The number of cars handled (582,790) has more than doubled, and the number handled in the past year is about 50 per cent. greater than the number reported in 1892; and the net revenue for the past year, over and above all refunds and expenses of administration, was $25,467. This is more than twice the net revenue of any previous year. The percentage of cars released within the free time has been maintained very steadily, for seven years, at between 97 and 98 per cent. The average detention by the railroads for the last two years was only three-tenths of a day. Manager Gardner, in his report, says that this small average would have been materially reduced but for the unfavorable conditions at the yards where harbor delivery is made in Baltimore. The uncollected charges, which amount to only a little over one per cent. of the earnings, are all practically covered in credit accounts or by goods held in storage for charges. This association now embraces 26 railroads and daily reports are made to the central office from 600 stations.

NEW PUBLICATIONS.

Master Car Builders' Association.—The report of the Proceedings of the thirty-fourth annual convention of the Master Car Builders' Association, held last June, is received. Copies of this valuable document may be had from the Secretary of the Association, Mr. J. W. Taylor, The Rookery, Chicago, Ill. The report is an octavo volume of 424 pages, and contains a list of members with the names of officers and committees, the constitution and by-laws, the reports presented at the convention and the discussion thereon and the standards and recommended practice of the Association, together with illustrations of such standards and recommended practice.

TRADE CATALOGUES.

The Dodge Mfg. Co., Mishawaka, Ind., has issued a circular descriptive of a new disc grinding machine for removing rough surfaces from forgings and castings where the surfaces are flat. The discs are made true and a table is provided so that parallel faces or faces at any angle can be ground accurately. The discs are steel, 18 in. in diam. and ½ in. thick, covered with emery paper or cloth, and the covering can be easily renewed. The shaft carrying the discs is run at 2,200 r.p.m.

Roney Stokers.—Messrs. Westinghouse, Church, Kerr & Co. have issued a circular containing a list of some of the recent buyers of Roney mechanical stokers. This list is headed by the Manhattan Railway Co., of New York, with 34,000 h.p.; but the combined power houses of the Metropolitan Street Railway and the Third Avenue will develop still more power, namely 59,000. The plants mentioned go down as low as 200 h.p., this being for the Calumet & Hecla Mining Co.

Lumber Dry Kilns.—The American Blower Company, Detroit, Mich., has issued a new pamphlet descriptive of the theory, practice and apparatus of drying lumber. This includes the hot blast apparatus, trucks and other equipment, together with statements from numerous users as to work already done.

Perforated Metal.—The Robert Aitchison Perforated Metal Co., Chicago, issue a little pamphlet, showing a number of examples of perforations in sheet metals. The full list of sizes covers over 600 varieties. The pamphlet also contains tables of weights and gages and a price list.

Phosphor Bronze.—The Phosphor Bronze Smelting Co. issues a catalogue and price list under date of Sept. 10. This may be had by addressing the company at 2200 Washington avenue, Philadelphia, Pa.

Eyes and Headlights.

(*Continued from page 671.*)

disaster. The air is never so free from dust and vapor that this strong pencil of light cannot be seen even if no solid object lies in its path. There is urgent need of better light as long as it is possible for a fast mail train to overtake and destroy two hand cars loaded with people on a straight track having two miles clear view ahead of the engine; for a second section of a night train to close up its five-minute interval and smash a caboose after being in easy sight of the first section at least three times in the previous six miles; while a lo-

comotive, having been pushed past the switch at a meeting point on a curve, is so completely hidden as to be discovered only when struck by the opposing engine; while a landslide, and a freight train there wrecked, cannot be seen by a passenger engineer, with a half mile clear view, in season to save his own life and those of his passengers; while, on a mile of straight track, freight cars protruding from a siding cannot be identified in time to save a passenger train from wreck; while a tired engineer cannot decide, without a second look, whether the visible light ahead is a switch light comparatively near or a dim headlight farther away, and only makes up his mind after opening the throttle and taking a fresh start at it, to learn that it is a headlight; while it is possible for a "jack-pot" of five freight trains to form on the open plains at night, three trains opposed to two, on the main line, four miles beyond the meeting point, because somebody wrote a 5 for a 3 on a train order, and because also an engineman had difficulty in identifying unexpected headlights. These incidents could be multiplied without drawing upon things that did not occur, but which might have been.

The Treatment of Water for Boilers.*

By H. Stillman, *Engineer of Tests, Southern Pacific Company.*

There is some misconception of the term "pure water." We know it does not contain solid matter, but rain water or distilled water, while chemically pure still has a very corrosive action on iron. When the solid matter in water that forms scale exceeds ten grains per gallon, it will begin to form an increasing deposit on flues and boiler fire-box sheets that tends to decrease, more or less, the heat conducting quality of the plates. This is a matter that has been largely discussed and statements as to a loss of 15 per cent. fuel for 1-16 in. scale, and 30 per cent. for ¼ in. scale, are generally accepted. Unquestionably the nature of the scale modifies this very much. A hard scale of sulphate of lime conducts heat fairly well. Softer and magnesia scales undoubtedly do cause considerable heat loss. We see, therefore, that in this matter the nature of a scale producing water has much to do with its effect; that is, on the kind of scale it will deposit. The corrosive action of bad water is generally due to action of certain salts contained which, under the influence of heat and pressure, are decomposed and acids set free to attack whatever they have the most affinity for.

Corrosion and scale formation has been largely increased by the heavier pressures now carried on modern locomotives, with the increased heat which this pressure implies. On certain sections of our road, where, 20 years ago, boiler pressures did not exceed 125 lbs., there was comparatively little trouble with corrosion. Now, with 175 or 200 lbs. steam, there is considerable trouble. A proof of this is given in information from certain pumping stations where water was giving no trouble when the pump boilers carried but 60 lbs. Locomotive boilers using this water were suffering from it under 180 lbs. steam though the pumper called the water good. We will define the treatment of water as meaning any method by which the solid matter naturally contained in solution may be reduced or eliminated to the effect that less deposit and corrosion may occur within the boiler.

Without doubt distillation is preferable, as all solid matter is separated. The quality of the water treated cuts no figure in the matter. It only needs to be wet. A small proportion of the original water mixed with it will prevent the trouble found with use of distilled water on boilers. Unfortunately the cost of fuel with us prevents use of such method of treatment, besides first cost of elaborate apparatus. According to the test figures given by an English firm, whose apparatus is used in purification of sea water, it would cost, in Arizona, nearly 90 cents per 1,000 gallons to produce water by this means. The cost per 1,000 engine or train miles to supply such water would be $64.28, based on test figures and mileage of a year on one of our bad water divisions. The same division shows for the same year, a cost of $20.84 as covering the total labor and material for boiler attention and repairs per 1,000 engine miles. A comparison of these figures will show the uselessness of following up this method in light of present appliances.

Another method is by heating the feed water before entering the boiler. Temporary hardness is reduced by deposit of carbonate of lime, and with some waters this treatment is sufficient. For stationary boiler practice, the method is excellent where exhaust steam is available as in combination with a heater. One system is in use which uses live or superheated steam in a heater whereby a heat of over 300 deg. is applied to the feed water. With certain waters, as before referred to, the system is admirable as applied to a stationary plant. I have known such systems adopted however and condemned as of little value when the character of the boiler water was such that little or no good could be accomplished by the method.

For regular locomotive practice, the use of compounds has been found of little value. This is owing chiefly to two causes: First, that the locomotive boiler is called upon to evaporate more water in less time than any other type, and the proportion of compound to suit demands cannot be introduced successfully, and second, that the quality of the water as taken at different water stations is variable. For some time we followed the practice of putting carbonate of soda or soda ash into locomotive tenders as nearly as possible suited in proportion to amount of water taken, and to suit the quality of water. Owing to irregularity of service and the impossibility of exactly proportioning the amount of soda required, there was frequently trouble from foaming, and the practice was abandoned as benefits derived were less than difficulties experienced.

The next method of water treatment we will consider is that of chemical treatment whereby certain substances are introduced and mixed with the water at the water station to chemically convert acids and precipitate, as far as may be practicable, the solid or scaling matter naturally contained. This method is coming to be known as the most feasible way to deal with water, as by this means it is rendered as good as it may be made before it enters the boiler at all, and is the only practicable method in railroad service whereby the locomotive may draw from each supply, water that has been freed from objectionable matter. The chemical treatment consists of adding quick lime and soda ash or carbonate of soda, in such proportion as to convert the troublesome sulphates and chlorides of lime and magnesia into carbonates of lime and magnesia, and the formation in their place by chemical affinity of sulphate of soda and chloride of soda or common salt. The quick lime that is added absorbs the carbonic acid present and renders the carbonates lime and magnesia insoluble, precipitating them as chalk. The action of the quick lime is one of the simplest reactions in chemistry and easily understood. Limestone or carbonate of lime is burned in kilns for the purpose of driving off by heat the carbonic acid which makes it carbonate of lime. The lime produced is simply oxide of lime. This oxide of lime has great affinity for carbonic acid, and will absorb it again greedily, so that its natural form of carbonate of lime, limestone or chalk, which are chemically the same thing, may be assumed again. The water we are treating always contains carbonic acid, which has dissolved limestone in its passage through the earth. When we add quick lime, this acid is absorbed, as above explained, and the result is that both are precipitated in the treated water; what we have added and that contained. This part of the process is simple and effective. The carbonate of soda was added for the purpose I have above explained, to reduce the sulphates and chlorides not affected by quick lime. What remains in the water after its use brings us to the limit of what we may expect to do. The sulphate of soda and common salt formed, are neutral within the boiler and do no harm when their quality is not excessive. If contained in excessive amount, they may cause priming. Most of our bad waters naturally contain these alkali salts, and when the amount of soda ash or carbonate of soda necessary to reduce the sulphates of lime, etc., is large or begins to exceed 2 lbs. per 1,000 gals., the quantity of alkali salts produced becomes troublesome when considered together with what may be naturally contained. Chemical analysis of the water is the only way to find out what the effect of our treatment is going to be, and whether it will pay to treat it or not. Hit or miss methods of treating water by cure-all methods you will readily see are liable to make trouble. Carbonate of soda in boiler water produces a soapy condition and tendency to foam when it exists as free carbonate of soda. When added in the right proportion, if necessary to add at all, it does not remain carbonate of soda but is converted into other things, as has been explained.

As before stated, we cannot always reduce entirely the objectionable matter, and it is never possible to mathematically introduce the exact proportion of substances required. This is due to three reasons chiefly: First, the fact that the management of the treating plant has generally to be left to ordinary labor; the second reason is that water supplies are almost all subject to variation. The character of the supply does not change, but it may be a little worse at some times than others. We have had instances where supplies had materially changed, requiring quite different treatment. The treating plant requires simply a change in proportion of chemicals added. Within ordinary limits, the proportion is based on average condition of the water supply. Our treating plant is automatic within reasonable limits, and the ordinary intelligence referred to in giving it attention is simply that of routine. A third reason for not practically obtaining exact results is in slight variation of quality of the commercial lime and soda ash used. The soda ash usually runs 92 to 95 per cent. pure. The lime used varies somewhat more, depending much on care used in obtaining it specially for the purpose. You will see, as practical men, that like all other details of our business, the matter of water treatment requires following up. Often it has been abandoned as useless, probably because it was not followed up and remedies applied systematically. It is really as practical a matter as others we all have in hand.

*Extracts from a paper read at the September meeting of the Pacific Coast Railway Club.

Improvements on the Grand Trunk.

Extensive improvements have been made during the past few years on the lines of this company. One of the results is that the "Imperial Limited," which formerly required 12 hours for the run from Montreal to Toronto, 333 miles, now makes the run from Montreal to Detroit, 557 miles, in the same time. Double tracking is nearly completed between Montreal and Toronto. A double track bridge is being built over the river Trent and the grade is very much reduced at Trenton. Similar work has been done at Vaudreuil, and double tracking is in progress between Hamilton and Niagara Falls. The 335 miles between Port Huron and Chicago is partially double tracked, and work is being pushed on the remainder. The grades are also being reduced and 80-lb. steel being substituted for lighter rails.

The Niagara steel arch bridge was opened in September, 1897, taking the place of the old suspension bridge. The Victoria Jubilee Bridge over the St. Lawrence River at Montreal, replacing the old tubular bridge, consists of 24 spans, of 242 ft. each, and one central span of 330 ft., making a total length of 6,592 ft. It is a double-track bridge with a driveway on one side and walk on the other. The old bridge weighed 9,044 tons. The new one weighs 22,000 tons, and cost about $2,000,000. The International bridge connecting Fort Erie, Ont., with Buffalo, N. Y., is practically two bridges, one of eight spans across the Niagara River proper, 1,967 ft., and the other over Black Rock Harbor, 517 ft. long, with a draw of 214 ft. This bridge is being rebuilt by the Detroit Bridge & Iron Works, and will be finished by the end of the year at a cost of $300,000. The smaller bridges over the entire system have been improved. Every bridge has been renewed on the main line between Montreal and Portland.

The yards and buildings have been rearranged and improved at many important points, such as Toronto, Sarnia, Port Huron, Niagara Falls and Fort Erie. At Sarnia and Port Huron new engine houses of 30 stalls capacity, with modern coal chutes, sand houses, etc., have been built. Switching, coaling and watering facilities have been improved at Toronto, Belleville, Montreal, London, Hamilton, Island Pond, Portland and other large terminals. Many of the old wooden stations have been replaced by brick buildings. A five-story general office building is being built at Montreal on a site given by the city. It will occupy an entire block, 200 ft. x 133 ft., and will double the present office space. Its estimated cost is $500,000. Offices have been built at Point St. Charles for the Motive Power Department, and arrangements have been made with syndicates under which elevators have been built at Midland and Goderich. Another elevator is being built at Meaford on Georgian Bay. To accommodate this building the line has been changed from its old position to a location on the harbor. The company has spent large sums for new rolling stock, and has equipped cars and engines with automatic air-brakes and couplers at a cost of $1,100,000.

The capital stock has an enhanced value of some $80,000,000 over the market price of 1895 and the early part of 1896. This improvement is largely due to the increased payment of dividends to the English stockholders, amounting to $3,762,434, for the four years ended Dec. 31, 1899. A deficit in the interest on the perpetual debenture stock which existed on Dec. 31, 1895, has been earned and paid since that date, amounting to $4,856,009.

This dividend payment is only $2,814,025 less than the net dividends earned in the entire 10 years preceding the time when Mr. Hays took charge of the property. Since that time the company has added the Central Vermont to its system. This line, 750 miles long, affords an outlet for the Grand Trunk to New York and Boston. Under the recent reorganization of the Central Vermont, the Grand Trunk was awarded more than two-thirds of the stock, as well as a large proportion of the $12,000,000 of bonds issued in settlement of its claims against the property. The Grand Trunk has leased a portion of its line between Toronto and Hamilton to the Canadian Pacific, between the St. Clair and Niagara rivers to the Wabash, and a section east of Montreal to the Intercolonial. This leasing was to prevent duplication of the line, and has proved a good business policy.

Comparative Cost of Power Generation by the Steam Engine, Water Turbine and Gas Engine.*

There is no question of greater importance at the present moment to those engaged in the management of our manufacturing industries than that of power generation. The supremacy which the steam engine has so long enjoyed is now assailed from two sides. The water turbine and the gas engine have become dangerous rivals. During the past ten years a most remarkable development of hydraulic power has been taking place on the continent of Europe in France and Germany, and in America at Niagara. The aggregate amount of power at the present date generated from falling water forms no inconsiderable portion of the total power utilized in manufacturing industries; and two years ago it was estimated by the author to be between 236,000 and 350,000 h.p. On the other hand gas engineers have been busily engaged in working out the problems presented by large gas engines and by the utilization of the waste gases of blast furnaces. Gas engines up to 650 h.p. have been built, and have worked smoothly and economically, while at Seraing, in Belgium, and at other places the blast furnace gases have been utilized for driving the engines which supply the blast.

It is no doubt true that the choice between the three possible sources of power is one which in many cases will be settled purely by local considerations; and the proximity of a large waterfall or of an extensive coal field to the factory, will be held to point to the turbine or to the steam engine as the most economical power generator. In a great number of cases, however, especially when the decision of the engineer covers the choice of a site for the

*Extracts from a paper by John B. C. Kershaw, F. I. C., read at the Bradford meeting of the British Association for the Advancement of Science.

factory, the problem is capable of no such easy solution; and the most economical source of power can only be determined after an exhaustive study of comparative cost data.

The aim of the writer in the present paper has been to collect and arrange in comparable form some of the more important figures bearing on the cost of power generation. Full references are given to all the original articles from which these figures are drawn.[1]

Taking the best figures for each of the three sources of power dealt with above, and bringing them all to a common basis of comparison, namely, the cost of the E.H.P. year of 8,760 hours, the author obtained the figures given below.

Comparative Costs of Electrical Power.

Lowest Cost per E. H. P. year of 8,760 hours.

Source of Power.	Estimated. £	s.	d.	Locality.	Actual. £	s.	d.	Locality.
Water	1	5	5	Canada	1	19	0	Switzerland
Steam	4	18	8	N. England	4	9	7	U. States
Gas (Producer)	5	0	0	England				
Gas (Blast Furnace)	4	1	7	Germany				

The figures in the table support the opinion, now generally held, that water when developed without excessive capital expenditure is the cheapest source of mechanical or electrical energy. When, however, the hydraulic engineering expenditure has been heavy, or when the power, after generation, has required to be transmitted over long distances, the margin between the relative costs of water and steam power is greatly narrowed, and in some cases disappears.

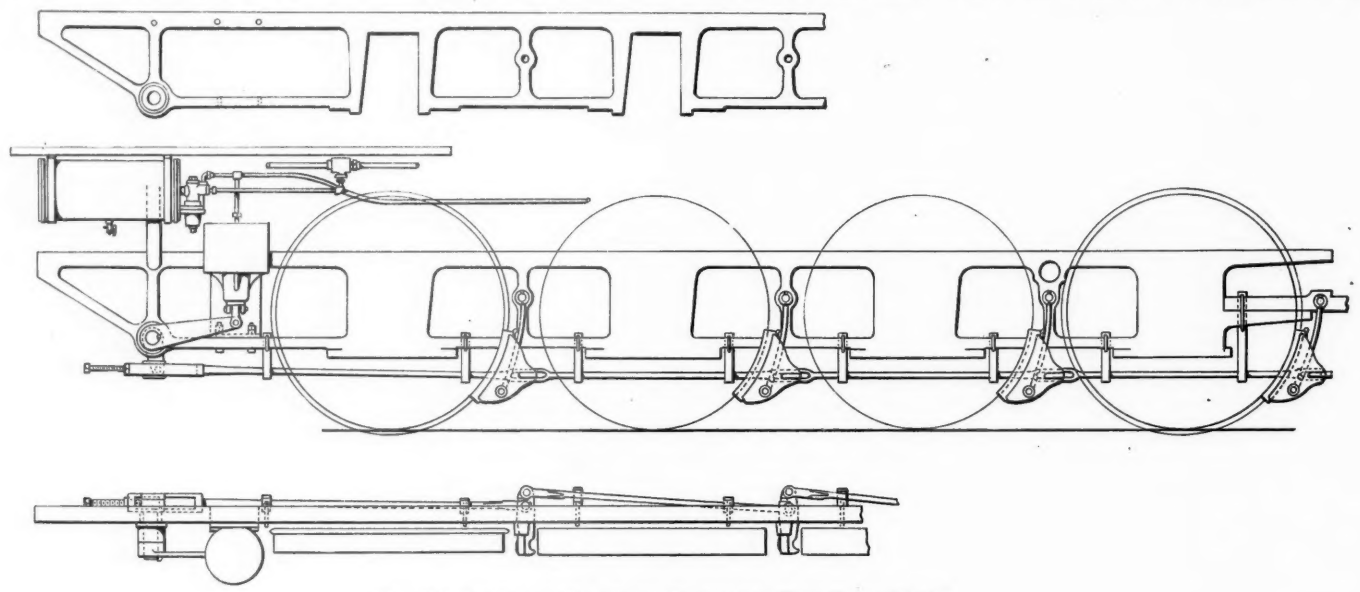
Electrical energy generated by falling water is costing more at Rheinfelden, at Zurich, and at Buffalo than it would cost in South Lancashire if generated by steam power in large units; and the margin between the actual charge for power at Niagara and the estimated cost of steam power in large generating stations in South Lancashire is only 12s 1d per E.H.P. year.

Turning now to a consideration of the relative position of gas power, the question of the practicability of large engines may be taken as settled. If they do not cost excessive sums for maintenance and repairs, large gas engines, in conjunction with coke ovens and blast furnaces, may entirely alter the present position of affairs; and the new industries which at present are being established in the neighborhood of water-power stations may find themselves in severe competition with similar manufactures carried on in the coal and iron districts of the older manufacturing countries. It has been calculated that 2,000,000 h.p. is annually wasted in the gases issuing from the blast furnaces of the United Kingdom. If these waste gases could be industrially utilized in the manner suggested, we should to a large extent be compensated for our lack of natural water power. But blast furnaces demand coke, and coal beds are exhaustible, so that even if this source of mechanical and electrical energy be tapped it can only postpone, but not avert, the final triumph of the waterfall and of the turbine.

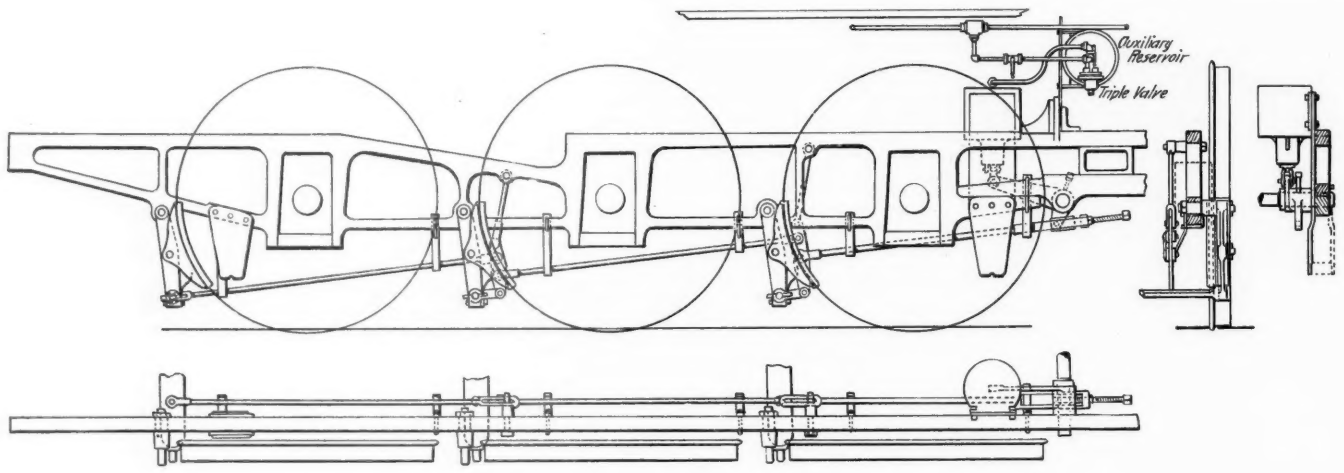
[1] Tables I. to VI. contain details of sixty-five actual or estimated costs of steam, water, or gas power per h. p. year of 8,760 hours.

Locomotive Driver Brakes.

In the last catalogue of the American Brake Co., St. Louis, Mo., special attention is called to several examples of locomotive frames designed to take the fulcrum and suspension points of brake gear, and two views are reproduced to illustrate this feature. One is a frame for a locomotive with eight drivers coupled and the other for an engine with six driving wheels. It will be seen that instead of using castings bolted to the frame to furnish points of support, as has been the common practice, the frame is designed so that the studs and fulcrum shaft pass directly through the frame. At these suspension points the frame has to be reinforced, so that this construction is only applicable to new engines. Heretofore there has been a large number of brakes fitted to old engines and it was necessary to use castings and attachments of various kinds, although the bolt holes necessarily weakened the frames. There is no reason, however, why such complicated attachments should be used with new locomotives and already many of the latest engines have frames designed as shown by the accompanying engravings. They may be taken as examples of approved practice.



Consolidation Locomotive Frame Designed to Take Brake Rigging.



Approved Application of Brakes to Ten-Wheelers.

The International Sleeping Car Co.

In an account of the rise and growth of the International Sleeping Car Co. Dr. von der Leyen says that it was founded by a young engineer belonging to a well-to-do family in Liege, Belgium. This young man, George Nagelmakers by name, after finishing his studies made a journey through the United States between 1865 and 1870, just at the time when the late Geo. M. Pullman was making a reputation for his luxurious sleeping cars. Those whose memory goes back far enough will remember the excursions to the scene of construction of the Union Pacific, when it had got well beyond civilization, and the numerous invited guests, among whom were numbers of prominent members of Congress, and above all newspaper men. These were carried past countless herds of buffalo, and entertained by war dances of real wild Indians, and meanwhile lodged in gorgeous (though somewhat narrow) apartments, and fed on all the delicacies of the season and almost drowned in champagne. Nagelmakers was much impressed by this novelty in railroad traveling; but also by another feature of American transportation—the great number of street car lines in the cities at a time when they were almost unknown in Europe. On his return he hesitated whether to devote himself to the introduction of street railroads or of sleeping car lines into Europe; but he finally brought about the organization of the International Sleeping Car Co., Jan. 4, 1873, with a capital of $100,000, and headquarters in Brussels. A considerable variation from the American model was then necessary to adapt sleeping cars to the European railroads and their customs. Then, passenger cars on trucks were unknown on most European railroads, though now they are common; and all, or nearly all, this company's cars are now eight-wheeled with entrances at the ends; though the "stateroom" prevails instead of berths reached from a central passage, for which European cars are too narrow.

The enterprise thus begun has been prosperous and has grown greatly, though it bears but a faint comparison with its American prototype. In 1877 it had 58 cars, in 1887 205, in 1895 405, and in 1899 674, not including baggage cars. It has paid yearly dividends since 1877, which were at the rate of 5 per cent. in six years, 5½ in two years, 6 in three, 6½ in four, 7 in two, 7½ in three, 4 in one and 3½ in one, averaging a little less than 6 per cent. for the 22 years. Of late years its working expenses have been about one-half of its gross earnings. At present its capital stock is 50,000,000 francs, and its funded debt nearly 30,000,000, which is at the rate of about $24,000 per passenger car.

But the company, besides its rolling stock and construction and repair shops, owns some of the finest hotels in the world—one in Ostend, one in Paris, one in Lisbon, one in Nice, one in Monte Carlo, one at Abbazia (a winter resort on the east coast of the Adriatic), two in Constantinople, and one in Cairo. These are all in places to which it carries passengers in special limited trains, formed wholly of its own cars, and run usually at greater speed than other trains on the same lines, by special contracts with the several railroads composing such lines, at fares in excess of the ordinary first-class fares, besides the charges for berths. This is an innovation by this company, for which there is no precedent, we think, either here or in Europe. The first of these "trains de luxe," as they are called, was the "Orient express," from Paris to Constantinople, which ran first in 1883, when, indeed, a portion of the journey had to be made by steamer. Other trains now run are:

Northern express: Paris, Ostend, Berlin, St. Petersburg.

Southern express: Paris, Madrid, Gibraltar, Lisbon.

Peninsular express: Calais, Paris, Bologna, Brindisi.

North and South Brenner express: Berlin, Munich,

Verona, Milan, Nice, Cannes (with a car for Rome and Naples).

Vienna and Carlsbad express.

Calais and Rome express.

Mediterranean express: Calais, San Remo.

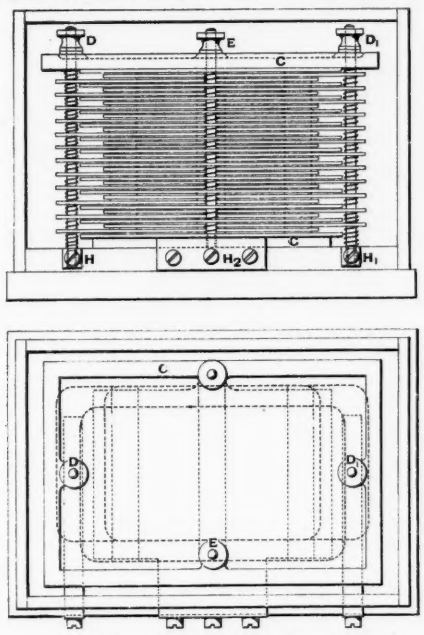
Engadine express: Calais, Basle, Coire.

Paris and Carlsbad express: Paris, Strasburg, Stuttgart, Carlsbad.

The company has general offices in Brussels, Paris and Berlin. It employs about 2,600 men in its car service, 1,800 in its hotels, and 1,850 in its shops. Last year it furnished accommodations to 560,000 passengers, gave 1,600,000 meals, and ran cars over 76,137 miles of railroad. Its earnings were about $2,400,000, which may be compared with the Pullman Company's $9,748,000 "earnings from cars" in the last year before absorbing the Wagner Co.

Gattinger's Lightning Arrester.

In the *Railroad Gazette* of Aug. 24 we mentioned a lightning arrester, described by Mr. G. Wurtzler, of the Hungarian State Railroads, in a paper presented by him to the International Railroad Congress, which was reported to have given marked satisfaction in use on railroad telegraph and telephone lines. We show herewith a plan and elevation of this arrester. It consists essentially



Gattinger's Lightning Arrester.

of a series of layers of carbon sheets, three sheets in each layer. The largest sheets are about 6½ in. long x 4 in. wide. They are 1-16 in. thick. Of each layer of three sheets the upper is connected with the incoming wire, the lower with the outgoing wire and the middle one with the ground. Each sheet is separated from those above and below it by mica. The vertical metallic rods D, E, etc., connect the different plates which belong to the same circuit, the rod D, for instance, being connected with all of the grounded plates. The rods or supports also serve to hold the plates together, moderate pressure being applied by means of the screws at the top. The base is made of wood and the arrester when in use is covered by a wooden case, with openings at the top for ventilation.

TECHNICAL.

Manufacturing and Business.

Richard Lee Whitton has been appointed Sales Agent, in charge of railroad trade, for Berry Bros., Ltd., of Detroit, makers of varnish.

The 68 passenger cars being built by the American Car & Foundry Co. for the New Zealand Government railroads will be lighted by Pintsch gas.

The Michigan Lubricator Co., Detroit, Mich., informs us that the sales of its improved Michigan triple lubricator and automatic steam chest plug are steadily increasing. Among the more recent locomotives on which these have been specified are those built by the Schenectady Locomotive Works for the Minneapolis, St. Paul & Sault Ste. Marie and the Arizona & Southeastern and on some of the engines being built for the Michigan Central; also on six locomotives now being built by the Dickson Locomotive Works for the Grand Trunk.

Iron and Steel.

Charles F. Abbott, Auditor of the South Chicago works of the Illinois Steel Co., died in Chicago, Sept. 22.

The general offices of the American Sheet Steel Co. are to be removed from Pittsburgh to the Battery Park Bldg., New York City.

The National Steel Co. is about to send from Youngstown, Ohio, 40 cars containing 1,000 tons of rails for shipment to New Zealand.

The converter and billet mill of the Illinois Steel Co., and the Joliet plant of the Pressed Steel Car Co., were started up on Monday of this week.

Geo. F. McCleane, of Pittsburgh, formerly of Moorhead, McCleane Co., of the Soho Iron & Steel Works, makers of galvanized sheets and plates, died in Pittsburgh Sept. 30, at the age of 76.

W. E. Taylor has been appointed General Manager of the Republic Iron & Steel Co., and will have charge of the rolling mills, blast furnaces and steel plants. He will continue to perform the duties of Vice-President.

Bids for building six armored cruisers for the United States Navy will be opened at the Navy Department in Washington at noon on Dec. 7. Circulars describing the chief characteristics of the new vessels are now ready for distribution.

The American Bridge Co. has begun making large shipments on account of the steel work for the subway in New York city. Already about 2,000 tons have been shipped, and the material is now being sent in at the rate of about 100 tons a day. The total contract comprises about 80,000 tons of structural material, which is being made at the Keystone plant of the American Bridge Co.

The Sanitary District, Chicago, Water Power.

Just about a year ago (*Railroad Gazette*, Sept. 1, 1899) the sanitary district of Chicago rejected bids from private parties for a lease of the undeveloped water power at Joliet, Ill., and since that time the district trustees and Chicago City Council have been trying to reach an agreement whereby the city will control the water power. Such an agreement has now passed the Council, has been approved by the Mayor, and will doubtless be approved by the trustees of the sanitary district. Under this agreement the city is to develop the water power and pay the sanitary district $4 per horse-power per year. It is estimated that with a flow of 300,000 cubic feet of water a minute, about 22,000 h.p. will be available, and the necessary plant and transmission to Chicago is estimated to cost about $2,500,000. Current will be used for city lighting and for operating the several pumping stations. It is anticipated that there will be some difficulty in financing this project, as there is doubt as to the legibility of a bond issue for this purpose, and the question is now pending a decision of the courts.

Shops of the New York, New Haven & Hartford.

In the annual report of the New York, New Haven & Hartford we find the statement that it is proposed to enlarge the shops at Norwood and concentrate all the engine work for the Eastern District at that point. The shops for the repair of cars will be consolidated in one plant to be located at Readville.

Contract for Ferry Bridge and Float.

Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until 1 o'clock Oct. 13 for a ferry bridge and float for the New York Navy Yard. The float is an ordinary wooden pontoon, and the bridge is of steel, carrying two railroad tracks. It is 100 ft. long, and has three longitudinal girders.

The New East River Bridge.

It will be remembered that a preliminary injunction was granted last August restraining the Commissioners of the new East River bridge from letting the contracts for the approach spans, and at the time we gave a summary of the grounds on which the injunction was demanded. Judge Gildersleeve, of the Supreme Court of New York, has now declined to make the injunction permanent. He says that instead of the specifications for the steel, shutting out competition, at least six concerns can make this steel and others can readily fit their works to fill the contract. He points out that the steel complained of is a minute percentage of the total quantity required (in fact it is only the castings), and further says that the Court cannot sit in judgment on the exercise of proper discretion by the Commissioners as to the kind of steel to be used. One of the points raised was that the Commissioners specify compliance with the provisions of the state labor law as to the prevailing rate of wages. The Court declines to pass upon the constitutionality of this law, which matter is included in several cases already taken before the Appellate Division.

THE SCRAP HEAP.

Notes.

The Chicago & Alton no longer has newsboys on its trains.

Pensions for employees retired on account of old age will go into effect on the Pennsylvania Lines West of Pittsburgh on the 1st of next January.

On the Philadelphia Division of the Pennsylvania the size of freight engines is to be increased. At present most of the engines on this division are moguls; these are to be replaced with class H-6 engines.

The Lehigh Valley has increased the pay of enginemen on the largest class of freight engines on the Wyoming Division from $3.60 to $4. Freight conductors on that division have their pay increased from $2.40 to $2.80.

Chattanooga papers report that on the Knoxville Division of the Southern Railway the time interval between passenger trains is increased from five minutes to 15 minutes; the same rule applies between a passenger and a freight train.

The Bloomsburg Division of the Delaware, Lackawanna & Western has been changed to a right-handed road. Ever since the opening of the road in 1853 until now all trains have run on the left-hand track, where a double track was in use. This division is 80 miles long.

A man named Burke, who was stealing a ride on the top of a car in a passenger train of the Chicago & Alton, near St. Louis, one day last week, was attacked with a pistol by another tramp while the train was in motion and a fight ensued. Burke was shot in the side, but finally managed to push the robber off the car and he was fatally injured.

Mr. I. A. Sweigard, who recently resigned as General Superintendent of the Philadelphia & Reading, has been charged with criminal violation of the Federal labor law in discharging employees of the road who belonged to the Brotherhood of Railway Trainmen. A warrant was issued by the United States Commissioner for Mr. Sweigard's arrest, but his attorney appeared and agreed to produce the accused when he should be wanted, and the warrant was not served.

On the Mobile & Montgomery Division of the Louisville & Nashville an order has been issued that passengers must not hereafter be carried on freight trains. It is said that this order is issued in consequence of the difficulty, since the general introduction of the air-brake on freight trains, of moving the rear portion of trains smoothly enough to avoid injuring passengers. In a number of cases passengers have been injured while riding in cabooses, particularly on trains in which only a part of the cars were controlled by the air-brake.

A train of the Burlington road from Omaha bound for Kansas City was stopped on the night of Oct. 3 about three miles south of Council Bluffs, Ia., by two robbers who had boarded the train at the last station; and after compelling the engineman to move three cars some distance forward, away from the rest of the train, the robbers attacked the express car. They compelled the engineman to blow open one side of the express car with dynamite, but while they were doing this Messenger Baxter went out of the car on the other side and succeeded in shooting and killing the robber who was watching the engine. The other robber then ran away, without getting any plunder. Press despatches state that Messenger Baxter has received $500 from the railroad company, and will receive $1,000 from the Adams Express Company. The money was well earned. It is to be regretted that numerous other affairs of the kind have not offered an equally good opportunity for recognition of bravery.

The Louisville & Nashville has lately called on the bondsman of its local freight agent and cashier at Birmingham to make good a loss of $18,000, which the company has suffered by the delivery of freight to the Southern Brokerage Company without the production of the bills of lading. Carloads of grain, etc., coming from the West were to be delivered to the concern in question on surrender of the bill of lading; but when the consignees had not the money to get the bill of lading out of the bank the agent delivered the goods on a promise that the B. L. should be handed over on a future day. It appears that some of these promises were not fulfilled. According to the local papers there is some question whether the agent or the cashier is chiefly responsible. It is said that they claim that the custom of delivering in this way is one which has been specifically permitted by the company for a considerable time; and on this showing the bond company refuses to be responsible for the shortage.

Traffic Notes.

A freight bureau is to be established by the merchants of Norfolk, Va.

The Spokane *Spokesman* says that the Northern Pacific is carrying 45,000 bushels of wheat from the Big Bend country in Washington, to Omaha. Other shipments of wheat have been made from the State of Washington to Minneapolis and other Eastern cities.

The railroads leading eastward from Chicago have agreed to make an advance in the rates on grain to the seaboard Nov. 1 as follows: Chicago to New York, export, raised from 13.5 cents to 16 cents; domestic, 15 cents to 17.5. A meeting is to be held in New York, Oct. 16, to consider numerous proposed changes in classification.

The Yazoo & Mississippi Valley has notified the Railroad Commissioners of Mississippi that it will not put in force the reduced freight rates recently ordered by the Commission, basing its refusal on a clause in the company's charter which is held to exempt it from such state control. The Kansas City Southern has secured an injunction in the Federal Court at Little Rock to restrain the Railroad Commissioners of Arkansas from reducing rates on freight carried by this road from a point in Kansas through Indian Territory to another point in Kansas. Argument on the suit will be heard Nov. 5.

Press despatches report that the new Transcontinental Passenger Association, which was provisionally formed at Glenwood Springs, Col., in August, has finally become an assured fact, and that the headquarters will be at Denver. The negotiations have been rather slow and difficult owing to the wide divergence of view as between the northern transcontinental lines and those to the south, but all differences appear to have been settled so that a beginning is to be made. The chairman of the association is the veteran James Charlton, late of the Chicago & Alton. Mr. Charlton is too well known to need an introduction to our readers. The organization of the association is similar to that of the Western Passenger Association. The roads east of the Missouri River and west of a line extending through Chicago, St. Louis, Memphis and New Orleans have been asked to come in.

Railroad Regulation in Kansas.

We have insisted, ever since the first so-called railway commissioners' law was put upon the statutes, that the men who own the farms, the business men, stockmen, and railway shippers generally are not in favor of any sort of legislation looking to state control of railway traffic. The taxpayers are not in favor of fixing maximum rates by law and have no interest, direct or indirect, in any sort of court or commission to hold up the corporations. We have said this an hundred times, in the last twenty years; and now we have the positive proof of the truthfulness of everything we have written upon this sub-

ject. Mr. Robison, an old citizen of this county, and quite a shipper, has for years been at work trying to secure a readjustment or lowering of freight schedules in this state, and he has been as honest as persistent in his efforts to accomplish something in the alleged interest of the farmers. A short while ago he was put at the head of the state organization which has no other object but to work to cut down or readjust railway tariff rates. Believing the farmers were behind him, and feeling assured that they would stand by him, he announced himself as a candidate for the state senate from this county. He made his campaign solely on that issue. He said he had done something for the farmers, as a private citizen, and he believed he could do much more as a member of the state senate. Robison has no political ambition, while the men who know him best are positive his only desire to go to the senate was to secure railway legislation that to his mind would help the farmers. But he was turned down—turned down by the farmers. The defeat of Mr. Robison, on the railway issue, and by the very men who, it has all along been claimed, are demanding legislative control of railways, is proof, to our mind, that there is practically no such demand. In other words, the farmers and shippers prefer to let the railway managers run their lines without legislative interference. There is no other conclusion to be reached, after the verdict in this county. Mr. Robison is not a professional agitator, is not a political yawper who goes about the country pumping wind. He was aggressive in his campaign and thoroughly sincere; but the voters said they preferred that he remain at home. There is not now a line upon the Kansas statutes in relation to railway control; the state has no commission or railway court of any kind, and ought not to have. Railway people are like others. They want business and are unremitting in their efforts to get it. They are polite and accommodating to the public. Competition cuts rates as well as regulates them. Railway managers must earn the money to meet the demands of the stockholders, or lose their jobs. Kansas has more miles of railway, twice over, than is required; but the people hired, cajoled or bulldozed eastern men into constructing these lines; and now that we have them we ought to stand by them. Besides, no state has better built, finer equipped or better managed lines. These roads pay an outrageously unjust proportion of the taxes, are shown no mercy in the courts, while a great number of people insist that they shall be legislated out of existence. However, the people of this county are not in favor of anything of the kind, as was fairly expressed at the convention a short time ago. State control of, or legislative interference with, the railways of this state is not demanded by the men who own the property, pay the taxes and who furnish the bulk of the shipments. If this matter was submitted to the voters of the other counties in the state, as it was in this, the verdict would be the same. There is nothing in it.—El Dorado (Kan.) *Republican*.

A Proposed Railroad to Connect British Guiana With Brazil.

The American Consul at Demerara, British Guiana, under date of Aug. 23, submits a route for a railroad from tidewater in British Guiana, south to Manaos, Brazil. The suggested starting point is either at Georgetown, at the mouth of the Demerara River, the capital and commercial center of the country, or at Bartica, at the head of navigation, 50 miles up the Essequibo River. The line would run south up the Essequibo River; thence southwest to the valley of the Takutu and the River Blanco; thence south to the River Negro and down that river to Manaos on the Amazon. The entire line would be about 700 miles long, of which 375 miles would lie within British territory. He estimates that there would be a difference of over 1,200 miles of distance and of seven days in time in favor of the new route between Manaos and New York city.

Harbor Works for Recife, Brazil.

Bids will be received, until Nov. 30, by the Director General of Works and Communications, at Rio de Janeiro, Brazil, for works at the port of Recife, in the State of Pernambuco. The most important work is a quay having a depth of seven meters of water at the lowest tide; filling between this quay and the present shore line; installation of electric and hydraulic cranes; building warehouses and railroads along the quays and widening the road along the north quay.

Traffic at the Sault Ste. Marie.

The following figures are from the statistical report of lake commerce through the canals at Sault Ste. Marie for the month of September:

	U. S. Canal.	Canadian Canal.	Total.
Eastbound.			
Grain, bushels	1,395,489	202,000	1,597,489
Flour, barrels	907,252	132,786	1,040,038
Iron ore, net tons	2,151,593	132,214	2,283,807
Wheat, bushels	3,651,025	638,081	4,289,106
Passengers, number	2,495	1,869	4,364
Westbound.			
Coal, hard, net tons	43,139	2,400	45,539
Coal, soft, net tons	412,833	62,321	475,154
Passengers, number	2,715	1,201	3,916
Freight—			
Eastbound, net tons	2,647,251	177,760	2,825,011
Westbound, net tons	509,989	76,453	586,442
Total freight, net tons	3,157,240	254,213	3,411,453
Vessel passages, number	2,198	384	2,582
Registered tonnage, net tons.	2,784,075	263,460	3,047,535

Imports of Rails Into Italy.

The official statistics of Italy's foreign trade for 1899 are just out. The imports of rails amounted in value to about $426,740. The largest supplier in 1899 was Belgium, followed next by the United States, Germany, England and Austria-Hungary in the order given. In 1898 no American rails were shipped to Italy. It is reported that the three great Italian Railroad Companies will soon be in the market for large quantities of rails, and as most of the European works are crowded with orders in rails, the chances for American manufacturers should be first class, especially as freight rates to Italian ports are low. The three companies are: The Mediterranean (Societa Italiana per le Strade Ferrate del Mediterraneo) whose president is Count A. Sanseverino Vimercati, of Milan; the Southern (Societa Italiana per le Strade Ferrate Meridionali), Mr. S. Borgnini, of Florence, Director General; and the Sicilian (Societa Italiana per le Strade Ferrata della Sicillia), whose Director General is Mr. G. Mazza, of Palermo, Sicily.

Gold Medal to Dr. Scripture.

Prof. E. W. Scripture, head of the psychological laboratory of Yale University, has been awarded a gold medal at the Paris Exposition for his lantern for testing color-vision. This lantern was described in the *Railroad Gazette* of March 23, 1900.

The Right to Reserve Your Seat.

The daily papers report that Mr. G. W. Kemp, of New York city, has sued T. R. Smith for $1,000 for assault, Mr. Smith having, it is alleged, ejected Mr. Kemp from a seat in a passenger car in the Grand Central Station, New York, on July 23. Mr. Smith, bound for New Haven, entered the train, and, after putting his valise in a seat, went out on the platform for a minute. When he returned he found the valise moved and Mr. Kemp occupying the seat. In connection with this incident the question whether the right, usually accorded by courtesy, to retain a seat in which you have left your baggage or your hat, is also a legal right, is speculated upon by the reporter of the New York *Sun*, and in connection with his discussion he quotes Mr. Frank Loomis, counsel of the New York Central, as follows:

Mr. Loomis says that he has never known of a case involving this question in thirty-five years' experience, nor has he read of any adjudication by the courts in any of the law books. He, however, is of the opinion that when a man puts his valise or any of his hand baggage in a seat he thereby reserves it for his own occupancy, and is legally and morally entitled to occupy it.

"When a passenger," said Mr. Loomis, "buys a ticket he presumes that he is to get a seat, and unless there is some unusual condition he is legally entitled to a seat. If he enters an ordinary coach where no seats are reserved he finds no trainman to usher him to a seat. It is the custom of railroad companies to allow passengers in such coaches to choose their own seats. This practically amounts to a regulation of the company. If a person sits down in a seat and then for any reason leaves it without in some way marking it as reserved by himself and returns to find it occupied by another passenger, I am of the opinion that he has no right to ask this passenger to give up the seat. If, however, he leaves his cane or umbrella or hand bag in his seat and then goes to the platform to buy a paper or for any other purpose and returns to find his baggage moved and the seat occupied, I am of the opinion that he has a legal and moral right to that seat. He has the same right to it that he would have if he had been sitting there for an hour while the train was under way and had stepped to one end of the car to get a drink of water. If a man across the aisle stepped into the seat he would certainly not be entitled to it.

"Now, being wronged, how can he get this wrong righted? A passenger who had been deprived of his seat would certainly not have the right to eject the intruder forciby. He would have to sue. If I owed you $10 and refused to pay you and you should come into my office and see me counting a lot of ten-dollar bills you would have no right to take one of the bills. You should sue. If the passenger sued the man who took his seat he probably would not get much of a verdict, possibly not more than six cents, and yet it would be commensurate with the damage he had sustained. Another course open to him would be to appeal to the conductor of the train. The employees of the road could go to the intruder in the seat and ask him to give it up. They could say to him that he was violating the rules of the railroad company which recognized the right of the other man to that seat inasmuch as it permited passengers to select their own seats insead of assigning seats to them. If the man refused to vacate, the trainmen would have the right to eject him, using, however, only such force as was necessary to accomplish this end. In this case, if Smith used unnecessary force in obtaining possession of the seat, as the plaintiff will doubtless endeavor to show, a verdict may be rendered against him, although the court should decide that he was entitled to the seat. The point involved is a most interesting one, and a decision by a court of last resort will be necessary to establish the law upon it."

Prussian Freight Rates on Coal.

Under date of Sept. 8 Mr. Jackson, Secretary of the Embassy at Berlin, reports that the Prussian Ministry of State has decided that, in consideration of the difficulties connected with the coal supply, the importation of foreign coal will be facilitated by the reduction of its tariff to the general schedule of freight tariff on raw materials, which is decidedly lower than the old tariff on coal. The railroad authorities are directed to make the proper arrangements for carrying out this reduction.

New Roadway Prizes on the New York Central.

According to a circular which has been issued by Chief Engineer W. J. Wilgus, of the New York Central & Hudson River, prizes for good work on the track will hereafter take the shape of an increase of pay for twelve months instead of being given in a lump sum. The circular gives the terms under which the prizes will be awarded after the inspection which is being made during the present month. A man who merits a prize on this record will receive a certain sum each month until November, 1901, when, unless he merits the same standing in the record again, the premium will cease. The monthly premiums will aggregate, for twelve months, about the same as the single prizes formerly given. The circular says:

The Supervisor of Track of the sub-division receiving the highest percentage on each division, will be awarded $10 per month, and the Supervisor receiving the highest percentage on the System will be awarded an additional sum of $5 per month. . . . The Foreman of the section receiving the highest percentage on each sub-division $3 per month. The Foreman receiving the highest percentage on each division an additional sum of $2 per month. . . .

Particular attention is called to the items of Surface, Line, Drainage and Neatness, including Standard Roadbed, which will be given especial attention by the Committees. Kinky joints and mounds of ballast between tracks on any section will reduce the marking on "Line" and "Neatness" to zero respectively.

The Piraeus-Athens Railroad to Thessaly.

On March 22, 1900, a contract was signed between the Greek Government and the English company known as "Eastern Railway Construction Syndicate, Limited" according to which the latter has undertaken to build the railroad from Piraeus to Demerli in Thessaly, on the Turkish border, recently referred to in these columns (May 25, p. 345.) According to a special stipulation provided in the contract the Government is bound to extend this line to Larissa, and to start work on this prolongation no later than six months after the completion of the Piraeus-Demerli line.

The latter line will have a length of 438 km. (272 miles) and a gage of 1.44 meters (practically standard gage). It will run from Athens through Attica to Boeotia, touch the cities of Theben and Levadia, taking its way then through Phokis and Phthiotis, and crossing the Othrys Mountains in the neighborhood of Lianokladion. Besides this, it is intended to build two branch lines, one from Skimatri in northern Boeotia to Chalkis on Euboca, the other one from Lianokladion to Lamia with prolongation to Aja-Marina and Stylis, on the northern coast of the Bay of Lamia. For building the railroad the contractors must form a new company withing three months after the close of the war in South Africa, to be known as "Hellenic Railway Company," with 10,000,000 drachmas ($1,934,000) capital.

The trunk line Piraeus-Demerli must be completed within four years. The term of the concession is 99 years, but the Greek Government has reserved the right to buy the line after 25 years of operation. It is thought in Greece that this line will largely increase the trade between Turkey and Greece, and will especially have a great influence upon the mail traffic between Europe, India and the Far East, as it is generally accepted that the mail would then be conducted via Athens instead of Brindisi. The distance between Port Said and Piraeus is 600 km. (373 miles) shorter than that from Port Said to Brindisi. The saving in time for mail via Piraeus would be 33 hours for Budapest, 24 for Vienna, 12 for Munich, 20 for Berlin, 26 for Warsaw, St. Petersburg and Moscow, 14 for Brussels.

Compressed Air.

The stockholders of the American Air Power Company have formally voted to dissolve that corporation. This is one of the steps in the amalgamation of the various companies into the Compressed Air Company, concerning which our readers have already been informed.

LOCOMOTIVE BUILDING.

The Mexican Central is in the market for 15 locomotives.

The Schenectady Locomotive Works have an order for eight engines for Japan.

The Hilo-Kohala Railroad, of Hawaii, now building, is in the market for locomotives.

The Boston & Maine has ordered 10 engines, for fast passenger service on the Fitchburg division, from the Schenectady Locomotive Works.

The New York Central & Hudson River has ordered from the Schenectady Locomotive Works 20 of the locomotives referred to last week. They will be for passenger service.

The Chicago, Burlington & Quincy has ordered 30 Prairie type engines from the Baldwin Locomotive Works, delivery to be made in March and April, 1901. These engines will weigh 160,000 lbs., of which 120,000 will be on the drivers, and will have 20-in. x 24-in. cylinders. 200 lbs. working steam pressure, 231 iron tubes 2½ in. in diam. and 17 ft. ¼ in. long; steel fire-boxes 7 ft. x 6 ft.; water capacity, 5,000 gals.; coal capacity, 8½ tons. Special equipment includes Westinghouse air-brakes, steel axles, wooden single truss brake-beams, Ross-Meehan brake shoes, Chicago couplers and Leach sanders. The road will also build 10 or 20 of these engines at its Burlington shops.

The Davenport, Rock Island & Northwestern has ordered three 8-wheel simple engines for January, February and March, 1901, delivery, from the Baldwin Locomotive Works. They will weigh 106,000 lbs., with 67,000 lbs. on the driving wheels and have 18-in. x 24-in. cylinders, 68-in. driving wheels, wagon top boilers with a working steam pressure of 180 lbs. and 244 tubes 2 in. in diam. and 10 ft. 11 in. long; fire-boxes, 73⅞ in. long and 34¼ in. wide; and a tender capacity for 3,500 gals. of water and eight tons of coal. The specifications include Westinghouse brakes, Chicago couplers, Nathan and Monitor injectors, and Nathan "99" sight feed lubricators.

The Cincinnati, Hamilton & Dayton, as noted last week, is having two simple 6-wheel switching engines built by the Pittsburgh Locomotive & Car Works, to weigh about 91,000 lbs. They will have 18-in. x 24-in. cylinders, straight top boilers, 175 lbs. working steam pressure, 180 charcoal iron tubes, 2 in. in diam. and 13 ft. long. The fire-boxes will be 34⅜ in. wide and 64 in. long, of Otis steel. Water capacity 3,500 gals. and coal capacity eight tons. Special equipment includes Westinghouse air-brakes, hammered steel axles, Sterlingworth brake-beams, cast-iron brake shoes. Buckeye couplers. Ohio injectors, Sullivan's piston and valve packings. Coale safety valves, Leach sanders, Detroit lubricators. Detroit springs, steeled cast-iron wheel centers, Damascas bronze bearings and magnesia boiler coverings.

The Southern Pacific's recent order with the Cooke Locomotive & Machine Co. calls for 58 locomotives in all. 18 of which will be 8-wheel passenger engines and 40 mogul freight engines. The former are to be delivered this month and the freight engines will be delivered in December and January. The passenger engines will weigh 134,300 lbs., with 88,800 lbs. on the driving wheels and have 20-in. x 24-in. cylinders, 73-in. driving wheels, extended wagon top type boilers, radial stayed, with 300 charcoal iron tubes 2 in. in diam. and 12 ft. long, and a working steam pressure of 190 lbs.; fire-boxes, Carbon steel, 108⅛ in. long and 40¼ in. wide; and a tender capacity for 6,000 gals. of water and 10 tons of coal. The moguls will weigh 144,200 lbs., with 124,400 lbs. on the driving wheels and have 20-in. x 28-in. cylinders, 63-in. driving wheels, and a tender capacity for 4,500 gals. of water and 10 tons of coal. The other dimensions are the same as for the passenger engines. The specifications for both types call for Westinghouse brakes, Eastern Forge Co.'s axles, Cooke Locomotive & Machine Co.'s brake-beams, California and Janney couplers, Nathan injectors, Consolidated safety valves, Leach sanding devices, Nathan lubricators, French springs, Ashcroft steam gages, Latrobe driving wheel tires and American Steel Casting Co.'s driving wheel centers. The passenger engines will have brake shoes made by the Sargent Co., and Jerome piston and valve rod packings. The brake shoes and packings for the freight engines will be made by the locomotive builders.

CAR BUILDING.

The Hilo-Kohala Railroad, of Hawaii, now building, will require some passenger and freight cars.

The Chicago, Burlington & Quincy is having 200 freight cars built by the Haskell & Barker Car Co.

The Cincinnati, Richmond & Muncie, now building, has ordered 138 freight cars from the Laconia Car Co.

The Delaware, Lackawanna & Western has ordered 10 steel cars from the Sterlingworth Railway Supply Co., Easton, Pa.

The Chesapeake & Ohio has ordered from the Pressed

Steel Car Co. the 600 hopper bottom coal cars of 100,000 lbs. capacity referred to last week.

The Atlanta & West Point received bids, Oct. 10, on 100 box, 25 coal and 25 flat cars. The order is to be placed at once by the President and General Manager, Mr. Geo. C. Smith.

The Norfolk & Western recently asked prices on a number of cars of 100,000 lbs. capacity, to be built of both wood and steel, but as yet no bids have been received. The matter of ordering these cars has been dropped for the present.

The Davenport, Rock Island & Northwestern order with the Pressed Steel Car Co. for 25 steel flat cars of 80,000 lbs. capacity and 50 steel coal cars of 100,000 lbs. capacity, referred to last week, calls for Dec. 15 delivery. The cars will be equipped with Bettendorf bolsters, Sterlingworth brake-beams and Chicago couplers.

The Atchison, Topeka & Santa Fe order with the Illinois Car & Equipment Co. for 400 hopper bottom coal cars of 80,000 lbs. capacity, referred to last week, calls for cars to measure 31 ft. long over end sills, and 8 ft. 9 in. wide, with sides 6 ft. high. Player trucks and bolsters, Westinghouse brakes, Universal bearings and McCord journal boxes and lids will be used. The couplers and wheels will be furnished by the railroad. Part of the hopper doors of the cars will be equipped with the ordinary chain device and part with the Johnson hopper door.

The Pittsburgh & Lake Erie order with the American Car & Foundry Co. for 10 passenger cars, referred to last week, calls for April delivery. The cars will weigh 70,000 lbs., measure 61 ft. 3 in. long, 10 ft. 3 in. wide, and 14 ft. 4⅞ in. high; and will be equipped with Carnegie axles, National hollow brake-beams, Westinghouse brakes, Buhoup three-stem couplers, O. M. Edwards' window fixtures, Gold steam heating system, McCord malleable iron journal boxes and journal box lids, Pintsch gas, Standard steel platforms, American Car & Foundry Co.'s vestibules, Standard wheels and P. & L. E. standard draft rigging and trucks.

BRIDGE BUILDING.

BAKER CITY, ORE.—The Montana, Oregon & Pacific Ry., a road to be built from iron mines to the Oregon Ore Reduction Works, will need a steel bridge over the Snake River. Letson Balliet, General Manager, Baker City.

CLARION, PA.—Proposals will be received by the State Superintendent of Public Grounds and Buildings at Harrisburg, Pa., until Oct. 17, for the proposed steel bridge over the Clarion River near Clarion. Plans and specifications can be had from T. L. Eyre, Superintendent.

CLIFTON, ARIZ.—The Arizona & New Mexico Ry., changing to standard gage, is receiving bids for two steel bridges 150 ft. and 180 ft. respectively, estimated to cost about $35,000.

COLUMBUS, TEX.—Reports from this vicinity are that a rise in the Colorado River washed out a number of bridges. The Southern Pacific bridge is reported partly destroyed.

DAVENPORT, IOWA.—Reports state that plans have been made for a bridge over Rock River for the Davenport, Rock Island & Northwestern Ry. E. E. Hughes, General Manager.

DES JOACHIMS, QUE.—Joseph R. Roy, Acting Secretary of the Department of Public Works, Ottawa, Ont., will receive bids for the iron superstructure of the Des Joachims Interprovincial bridge over the Ottawa River, on Oct. 19. Keating, Wilson & Boucher, Snake Creek P. O., Ont., have the contract for the two piers, abutments and approaches.

FERNDALE, N. Y.—The New York, Ontario & Western has let a contract to the Rochester Bridge & Iron Works for a steel viaduct of plate girders, at Ferndale (formerly Liberty Falls) to replace the iron viaduct built in 1881. The dimensions are: Length, 981 ft., 90 ft. high in the center; center spans, 82 ft.; two other channel spans, 70 ft. 6 in. each. On approaches the shorter spans are 57 ft. 8 in., and the end spans 49 ft. 6 in. The estimated weight of the bridge is 1,442,000 lbs., of which 653,000 lbs. are in the towers and 789,000 lbs. in the girders. The bridge is calculated for rolling loads of 6,000 lbs. per 1 ft. The approaches are on a 4 deg. curve.

HARTFORD, CONN.—Reports state that the Street Board favors building a bridge over Holly Brook, on Franklin avenue, at a cost of about $21,500, part of which will be paid by the street railroad.

INDEPENDENCE, IND.—The County Commissioners have appropriated $30,000 for a bridge at Independence.

INDIANAPOLIS, IND.—The Marion County Commissioners want bids, until Oct. 13, for the superstructure for a bridge over Pleasant Run on Emerson avenue, in Irvington. Harry B. Smith, County Auditor.

MAHONINGTOWN, PA.—Reports state that the Pittsburgh & Western will rebuild the plate girder bridge over the Shenango River near Mahoningtown. The road is being double tracked at this place.

MARIETTA, OHIO.—M. F. Noll, Secretary and Manager of the Ohio River Bridge & Ferry Co., informs us that the bridge his company proposes to build over the Ohio River will be a highway structure about 2,500 ft. long, between Marietta, Ohio, and Williamstown, W. Va. The cost will be about $400,000.

NEW HAVEN, CONN.—Reports state that all the bids for the new bridge on Kimberly avenue over West River are rejected and new bids wanted.

NEW YORK, N. Y.—Major E. H. Ruffner, Corps of Engineers, U. S. A., will give a hearing, on Oct. 23, at the Army Bldg., in Whitehall street, on the application of the New York Connecting Railroad Company for permission to build a bridge over the East River between Mott Haven and Long Island City. The proposed bridge is to be a cantilever, 136 ft. above high water, and about 1,448 ft. long and 30 ft. wide. Alfred P. Boller is President and Engineer. The general office is 55 Broadway, New York.

The drawbridge on Hamilton avenue, over Gowanus Canal, Borough of Brooklyn, will be replaced by a double bascule bridge at a cost of about $100,000. It will have a clear opening of 65 ft., 34 ft. roadway, and will be 50 ft. wide over all.

OGDEN, UTAH.—The Weber County Commissioners want bids, until Oct. 16, for a steel bridge across Ogden River in Ogden Canon. C. R. Hollingsworth, County Clerk.

PHILADELPHIA, PA.—The contract for the steel bridge over the Philadelphia, Germantown & Chestnut Hill branch of the P. R. R., at Coulter street, Germantown, is let, according to report, to C. P. Weaver, at $20,000. The other bidders were: Hoffman Engineering & Construction Co., $28,585; David Peoples, $28,000; Richard Walsh, $27,335; Ryan & Kelley, $26,950; Harmer & Quinn, $24,703; Randolph & Baird, $24,400; S. B. Obdyke, $24,161; T. M. Reilly, $24,400; Philadelphia Construction Co., $22,980; P. McManus, $21,814.

The Survey Committee of the Councils has agreed to the following distribution of the $750,000 available for new bridges. These 13 bridges were included in the list in our last Construction Supplement, p. 560.

Frankford avenue, over Frankford Creek	$100,000
Thirty-third street, over Penna. R. R. and Reading R. R.	125,000
Allegheny avenue, under North Pennsylvania R. R.	40,000
Rising Sun avenue, under North Pennsylvania R. R.	91,000
Lehigh avenue, under connecting railway	74,000
Gibson avenue, over Baltimore & Ohio	25,000
Fifty-second street, over Phil. & West Chester R. R.	25,000
Seventy-first street, over P. W. & B. R. R. (temporary)	12,000
Oak lane, over North Pennsylvania R. R. (city's share)	10,000
Chew street and Walnut lane	70,000
Dauphin street	40,000
Passyunk avenue	75,000
Seventeenth street, over Germantown Railroad	63,000
	$750,000

PITTSBURGH, PA.—The Duquesne Borough Council, on Oct. 4, authorized an increase in the bonded indebtedness to the amount of $20,000, to build a steel bridge over Patterson Hollow.

The County Court has been petitioned to build a bridge across Thompson's Run at Center avenue, Village of Newton.

WILLIAMSPORT, MD.—Reports state that subscriptions are being solicited to build a $45,000 bridge over the Potomac River between Washington County, Md., and Berkeley County, W. Va.

Other Structures.

BELGIUM.—The Belgian State Railroad authorities are inviting bids for 33 locomotive turntables. Particulars may be had by addressing the Department of Road and Structures, Belgian State Railroads, 12 Henri Beyaert, Brussels.

DONORA, PA.—The Stanyon-Miller Engineering Co., 701-2 Empire Bldg., Pittsburgh, Pa., are consulting engineers for the rod, wire and wire nail mills for the Union Steel Co., at Donora.

EVERETT, MASS.—The New England Structural Co., of Boston, has the contract for the steel framework for the engine and boiler houses for the United States Steel Co. at Everett. The main building of the steel plant is 120 x 200 ft., and is about finished. Two 15-ton, open-hearth furnaces are being built.

GALVESTON, TEX.—At a recent special meeting of the stockholders of the Galveston Wharf Co. it was voted to borrow $400,000 for four years, at the rate of 6 per cent., to rebuild the property recently destroyed.

LITTLE ROCK, ARK.—The shops of the St. Louis, Iron Mountain & Southern R. R., recently destroyed by fire (Sept. 28, p. 643), will, according to report, be rebuilt at once on the same ground.

MIDDLETOWN, N. Y.—The New York, Ontario & Western has let a contract to the Dodge Coal Storage Co. for building a coal storing plant at Middletown, N. Y., with a capacity of four piles of 30,000 tons each, to be finished ready for use Jan. 15 next, and estimated to cost about $100,000.

MONTREAL, QUE.—Work is reported begun by the Conners Syndicate on the two large elevators and warehouses in Montreal Harbor. (April 13, p. 244.)

PHILADELPHIA, PA.—Armstrong & Printzenhoff have a contract from the Philadelphia & Reading to build a trestle about 570 ft. long, with coal pockets; also an ash dump 84 x 16 ft., on Lehigh avenue west of Trenton avenue. The total cost will be $25,000.

PITTSBURGH, PA.—Plans are being made by the Pennsylvania R. R. for the new power house at Pittsburgh for the new union station. It is to be 270 ft. long and 50 ft. wide.

SAN FRANCISCO, CAL.—The Risdon Iron Works, which recently bought the property of the Pacific Rolling Mill Co., at San Francisco, will build a dry dock and several buildings, including the following: Machine shop, 308 x 100 ft., total lift over main floor, 45 ft.; boiler shop, 140 x 180 ft., lift over main floor, 40 ft.; machine and ship blacksmith shop, 300 x 60 ft.; foundry, 177 x 160 ft.; ship joiner shop, 140 x 81 ft. The machine shop will have a 50-ton, a 20-ton, a 15-ton and a 10-ton electric traveling cranes. The boiler shop will have three cranes, one of 60 tons, one of 20 tons and another of 10 tons capacity. The foundry will have a 30-ton crane and a 20-ton crane. As recently stated, the American Bridge Co. will build the machine and boiler shops and the foundry.

SAVANNAH, GA.—The Seaboard Air Line proposes to build a freight house 70 x 250 ft., at Savannah, Ga. Contracts will be let on the 12th.

WACO, TEX.—Reports state that the Missouri, Kansas & Texas proposes to build a $50,000 passenger station at Waco.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xi.)

Canadian Society of Civil Engineers.

The first ordinary meeting of the season was held on Thursday of this week at 8 o'clock p. m. The paper read was: "The Carillon Canal, Dam and Slide," by Mr. Ernest Marceau.

Northwest Railway Club.

A meeting of the club was held on Tuesday evening, Oct. 9, at the West Hotel, Minneapolis. Mr. George H. Horton read a paper on "The Traveling Engineer," and Mr. George P. Zachritz read a paper on "Repairs to Private Line Cars." Discussion was held on Mr. Horton's paper and also on "Wear of Locomotive Driving Wheel Flanges."

General Passenger and Ticket Agents.

The following subjects will be considered at the annual meeting of the American Association of General Passenger and Ticket Agents, at Buffalo, beginning Oct. 16: Commissioner L. P. Farmer, of the Trunk Line Association, "Prosecution of Ticket Forgers." C. E. E. Usher, "Placing Orders for Prepaid Tickets by Wire," and "No Convention Rates be Made Less Than Fare and One-Third Between Jan. 1 and Aug. 31 of Each Year." W. B. Kniskern, "The Issuing of Regular Rate Sheets Once in Six Months; Suggest May 1 and Nov. 1." M. G. Carrel, "Elimination of Brass Checks for Baggage, Both Local and Foreign."

International Association for Testing Materials.

The ballot for officers will be canvassed at the third annual meeting, and will be closed at 4:30 p. m., on Oct. 25, 1900. Members not attending the annual meeting may forward their ballots by mail to Richard L. Humphrey, Secretary of the American Section, Girard Building, Philadelphia, Pa. Messrs. Mansfield Merriman, Richard L. Humphrey and Paul Kreuzpointner having served as officers for over two years, state that they deem it to be for the best interests of the American Section that their names shall not be considered for re-election. The names given below have been suggested by several members and are indorsed by the retiring officers, who intend to propose an amendment to the By-Laws making the Chairman of the American section ex-officio the American member of the International Council:

For Chairman, Henry M. Howe; for Vice-Chairman, Charles B. Dudley; for Secretary, J. M. Porter; for Treasurer, Robert W. Lesley; for American Member of Council, Henry M. Howe.

American Society of Civil Engineers.

The following is the list of nominees for the offices to be filled at the annual election, Jan. 16, 1901:

For President—
J. James R. Croes, New York City.

For Vice-Presidents—
Henry S. Haines, New York City; representing District No. 1.
George H. Benzenberg, Milwaukee, Wis.; representing District No. 5.

For Treasurer—
Joseph M. Knap, New York City; representing District No. 1.

For Directors—
Josiah A. Briggs, New York City; representing District No. 1.
George F. Swain, Boston, Mass.; representing District No. 2.
Emil Kuichling, Rochester, N. Y.; representing District No. 3.
Mordecai T. Endicott, Washington, D. C.; representing District No. 4.
Frank C. Osborn, Cleveland, Ohio; representing District No. 5.
Edward C. Carter, Chicago, Ill.; representing District No. 5.

PERSONAL.

(For other personal mention see Elections and Appointments.)

—Mr. L. F. Barton, Superintendent Maintenance of Way of the Peoria, Decatur & Evansville, at Mattoon, Ill., has resigned to become Assistant Manager of the Sloss-Sheffield Iron and Steel Works at Birmingham, Ala.

—Mr. James P. Curry, Auditor of the New York, Chicago & St. Louis at Cleveland, Ohio, died at his home in that city Oct. 5. Mr. Curry was born in 1845 in Jefferson County, Ohio, and entered railroad service in 1864 as clerk on the Pittsburgh, Columbus & Cincinnati. In 1877 he became Auditor and Secretary of the Scioto Valley, and five years later Auditor of the company he was with at the time of his death.

—Mr. L. Bush, as noted in another column, was appointed, on Oct. 1, Principal Assistant Engineer of the Delaware, Lackawanna & Western. His first railroad work was in 1888 as Assistant Engineer on Maintenance of Way on the Iowa Division of the Union Pacific, and on location survey for the Pacific Short Line. After spending two years with the Union Pacific he was, until 1896, connected with private companies in charge of bridge work. During 1897 and 1898 he was Assistant to the Bridge Engineer of the Chicago & Northwestern, and the following year a Division Engineer on the Iowa Division of the same company. During this year he has been a Bridge Engineer of the Delaware, Lackawanna & Western.

—Mr. Frank S. Stevens, Superintendent of the Reading Division of the Philadelphia & Reading, at Reading, Pa., was born in Athens, Pa., Dec. 7, 1850. From Cornell University, he entered railroad service in 1870 with the Utica, Ithaca & Elmira, and remained with that company until 1877. For the two years following he was Chief Engineer of the Cazenovia, Canastota & De Ruyter, and then in 1880 Chief Engineer of the Long Beach Marine Railway. In 1881 he was Locating Engineer of the Chippewa Valley & Superior, and the following year Superintendent of Construction on the Sabine & East Texas. From 1882 to 1884 he was Division Engineer of the New York, West Shore & Buffalo, and the following year Principal Assistant to the Chief Engineer. He was Engineer of Maintenance of Way of the Elmira, Cortland & Northern and the Canastota & Northern in 1887. In that year he went to the Philadelphia & Reading and has continued with that company ever since. His recent appointment took effect Oct. 1.

—Mr. W. I. Allen is the General Manager at Richmond, Ind., of the Cincinnati, Richmond & Muncie, a railroad now building between Richmond and Muncie, Ind. Mr. Allen was born May 9, 1851. He entered railroad service at the age of 12 with the Michigan Southern & Northern Indiana as a telegraph operator at Wauseon, Ohio, and later served the Chicago & Great Eastern at Logansport, Ind., until 1867, in the same capacity, when he was appointed Train Dispatcher of that company at the same office. He served as Train Dispatcher also with the Chicago, Rock Island & Pacific, the International & Great Northern and the Texas & Pacific, besides some years of service as freight and passenger conductor for various roads. From 1881 to 1883 he was Superintendent of Transportation for the Cairo & Vincennes; then for three years Trainmaster for the Minneapolis & St. Louis. Following 1886 he was connected with the Chicago, Rock Island & Pacific as Division Superintendent, building lines west of the Missouri River until 1888; General Superintendent until 1890; Assistant General Manager of the entire system at Chicago until 1899, when he resigned to look after private interests in the West. He received his appointment to his present company on Sept. 20 last.

ELECTIONS AND APPOINTMENTS.

Atchison, Topeka & Santa Fe.—F. T. Dolan has been appointed Superintendent of the Chicago Division, with headquarters at Chicago, Ill., succeeding Avery Turner, who succeeds Mr. Dolan as Superintendent of the Middle Division, with headquarters at Newton, Kan. H. A. Tice has been appointed Superintendent of the Oklahoma Division, with headquarters at Wichita, Kan., succeeding D. D. Bailey, assigned to other duties. Effective Oct. 10.

Atlantic & North Carolina.—J. H. Green has been appointed Master Mechanic, with headquarters at New Bern, N. C., succeeding W. R. Warters, resigned, effective Oct. 3.

Central of Georgia.—F. J. Egan has been appointed Assistant Superintendent of the First Division.

Chicago, Indianapolis & Louisville.—Charles Steele has been elected a Director.

Colorado Midland.—P. H. Cosgrove, heretofore General Foreman Car Department of the St. Joseph & Grand Island, has been appointed to a similar position on the C. M., effective Oct. 15.

Crooked Creek.—The officers of this company are: President, Jacob M. Funk; Secretary and General Manager, F. E. Willson, and Treasurer and Assistant to the General Manager, Geo. E. Burnham.

Delaware, Lackawanna & Western.—L. Bush has been appointed Principal Assistant Engineer, with headquarters at Hoboken, N. J., succeeding L. H. Evans, resigned, effective Oct. 1.

Emporia & Gulf.—The officers of this company, recently incorporated, are: President and Treasurer, S. F. Carter, Houston, Tex.; Vice-President and General Manager, J. P. Carter, Emporia, Tex.; Secretary, E. L. Crooker, and Traffic Manager, L. Davidson, both with headquarters at Houston, Tex. (See R. R. Construction column, Sept. 14, p. 614.)

Georgetown & Western.—A. B. B. Harris has been appointed Acting Superintendent, succeeding Superintendent J. K. Ritz, and C. C. Waller, General Freight Agent, succeeding T. W. Brightman.

Germantown & Augusta.—The officers of this company, referred to in the Construction column, are: President, J. F. Walton; Vice-President, J. E. Thompson, Jr.; Secretary, A. D. McDougle; Treasurer, J. C. Browning; General Manager, S. D. Rigdon.

Gulf, Colorado & Santa Fe.—A. S. Jennings, heretofore Acting Auditor, has been appointed Auditor.

Lake Shore & Michigan Southern.—C. W. Cross has been appointed Master Mechanic, with headquarters at Elkhart, Ind., succeeding J. O. Bradeen, resigned, effective Oct. 1.

Lehigh & New England.—Leonard Goodwin has been appointed General Superintendent, succeeding W. J. Young, resigned.

Louisville & Nashville.—T. E. Brooks has been appointed Assistant Superintendent of the Nashville Divisions, succeeding J. L. Welch, who becomes Division Superintendent at Birmingham, Ala., succeeding W. M. Newbold, deceased.

Mobile & Ohio.—The headquarters of Assistant Division Superintendent W. N. Jones have been removed from Artesia, Miss., to Montgomery, Ala.

Nashville, Chattanooga & St. Louis.—H. G. Maney has been appointed Assistant Comptroller and is succeeded as Auditor of Disbursements by J. H. McEwen, who, in turn, is succeeded by T. Bond as Assistant Auditor of Disbursements.

Newburgh, Dutchess & Connecticut.—In addition to his present duties as General Freight and Passenger Agent and Auditor Traffic Accounts, W. Underhill has been appointed Assistant General Manager, effective Oct. 1.

New York, Susquehanna & Western (Erie).—J. A. Middleton has been elected Third Vice-President, with headquarters at 21 Cortlandt street, N. Y., in charge of the financial and accounting affairs of the company.

Offerman & Western.—The officers of this company are: President, Henry P. Talmage, New York; Vice-President, J. J. McDonough; Secretary and Treasurer, W. B. Stillwell, headquarters at Savannah, Ga., and Superintendent, J. F. Gray, Offerman, Ga. (See Construction Supplement, July 27, 1900.)

Philadelphia & Reading.—C. A. Beach has been appointed Superintendent of the Philadelphia Division, with headquarters at Philadelphia, Pa., succeeding W. A. Garrett, transferred, and Mr. Beach is succeeded by A. G. McCausland, who will, in addition to his duties as Superintendent of the Wilmington & Columbia Division, assume those of Superintendent of the Atlantic City R. R. At the annual meeting First Vice-President T. Voorhees was elected a Director, succeeding the late Mr. Coster.

Pittsburgh, Johnstown, Ebensburg & Eastern.—F. G. Patterson has been appointed Vice-President and General Manager, with headquarters at Altoona, Pa.

Quebec & Southern.—A. H. Harris has been appointed General Traffic Manager, with headquarters at Montreal, Que. (See R. R. Construction column, May 4, p. 296.)

Rutland.—Wm. S. Jones has been appointed General Superintendent, with headquarters at Rutland, Vt., succeeding C. L. Pierce, deceased.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

Arkansas Southwestern.—Surveys are being made for an extension of this line from Pike City, Ark., northwest toward Fort Smith. The company was recently reorganized as successor to the Southwestern Arkansas & Indian Territory. (Railroad News, April 27, p. 280.)

Baltimore & Ohio.—Hamilton & Irvin, of Fairmont, W. Va., are reported to have taken a contract for extending the yard and side tracks at Fairmont.

Baton Rouge, Hammond & Eastern.—Bids are being considered, according to report, for this line from Baton Rouge, La., east about 45 miles to Hammond, and thence to Carriere, Miss., in all about 93 miles. S. L. Ballard, of Hammond, is Chief Engineer. (Aug. 24, p. 574.)

Boston & Maine.—At the annual meeting, on Oct. 9, the stockholders of the Concord & Montreal voted to authorize the building of an electric line from Concord, N. H., south about 35 miles to Hudson, which will practically parallel the company's steam line.

Bristol & Neshaminy.—This company, whose incorporation was recently noted, is to build a railroad in Bucks County, Pa., from a point in Bristol Township to the Borough of Bristol. The incorporators are: Geo. R. Waite, 1425 Spruce street, Philadelphia, Pa.; A. G. David, Windsor Hotel, Philadelphia, and James P. Ennis, Lafayette Hotel, Philadelphia. (Oct. 5, p. 661.)

Cincinnati, Georgetown & Portsmouth.—A report that the company will extend its line from Georgetown, Ohio, southeast to West Union, is premature. The matter is under consideration but no decision is reached. (Oct. 5, p. 662.)

Colorado Roads.—Surveys are reported in progress by the Colorado Fuel & Iron Co. for a line from the old Thompson mine near Sopris, about six miles from Trinidad, to run up the Las Animas River about 25 miles to new coal lands.

Coos Bay, Roseberg & Eastern.—Attempts are being made to revive the proposed extension of this line from Myrtle Point, Ore., via Remote and Camas, to Roseberg, 70 miles. (Construction Supplement, July 27, 1900.)

Davenport, Rock Island & Northwestern.—Wm. Kenefick & Co., of Chicago, have taken the contract for the extension from Moline, Ill., southeast to Peoria. Building is in progress. (Oct. 5, p. 662.)

Surveys are in progress for the extension from Clinton, Iowa, northwest toward Dyersville.

Des Moines, Iowa Falls & Northern.—A re-survey is ordered for this line from Iowa Falls south via Nevada and Cambridge to Des Moines. E. S. Ellsworth, of Iowa Falls, Iowa, is President. (Construction Supplement, July 27, 1900.)

Germantown & Augusta.—This company was incorporated in Kentucky, Oct. 2, with a capital stock of $20,000, to build a railroad in Bracken County, from Germantown to Augusta. The officers are given under Elections and Appointments. The principal office is at Germantown, Ky.

Grand Trunk.—Building is to be begun at once, according to report, on the Ottawa, Brockville & St. Lawrence line from Brockville, Ont., north about 60 miles through Carleton, Greenville and Leeds Counties to Ottawa. (Construction Supplement, July 27, 1900.)

Hawkinsville & Florida Southern.—A committee from Hawkinsville, Ga., is negotiating with the Enterprise Lumber Co., which owns this road from Worth, Ga., to Ausley, to extend it north about 30 miles to Hawkinsville.

Marquette & Southeastern.—This company has been incorporated in Michigan to build a railroad from Marquette to Manistique. The directors are: W. G. Mather (President), of Cleveland Cliff Iron Co.; E. R. Perkins, J. H. Wade, George Hayden, M. M. Duncan and H. R. Harris.

Marvin Creek.—This company, whose incorporation was recently noted, is to build a railroad from a point in the Township of Sergeant to a point in the Township of Hamlin, both in McKean County, Pa. The incorporators are: T. F. Richmond, Sheridan Gorton, Sheridan Gorton, Jr., W. V. Proin and J. F. Hungwells, all of Smethport, Pa.; D. C. Young, Burg Chadwick, Pa. (Oct. 5, p. 662.)

Mexican Roads.—A concession has been granted the Cananea Consolidated Copper Co. for a railroad from Naco, on the boundary between Mexico and Arizona, to run south about 40 miles to the company's mines in the State of Sonora. Surveys are reported in progress and the company is to begin building soon.

Montana, Oregon & Pacific.—This company proposes to build a railroad from Baker City, Ore., east 84 miles, via Flagstaff, Virtue and White Swan mines, Erwin P. O., Burkemont, Copper, Butte, Sanger, Cornucopia, Ballard's Landing, Decorah and Seven Devils to Helena, Idaho. The road is to run through a heavy copper belt containing many mines. A survey is completed to Ballard's Landing. The company expects to begin work in March, at which time contracts will be let. The maximum curve is 12 deg., the maximum grades 1.5 per cent. The track will be laid with 72-lb. steel, and ties will be cut along the right of way. No steel bridges will probably be required except over Snake River near Ballard's Landing. Most of the rolling stock will be steel ore cars of probably from 60,000 to 100,000 lbs. capacity. Of these about 60 will be needed, also a few box cars, flat cars and three or four coaches. The company will also need about four locomotives. No bids or estimates for rolling stock have as yet been considered. Machine shops will be established a little later at Burkemont. The railroad is to furnish facilities for getting ore to the company's new smelters now building. Letson Balliet, of Baker City, Ore., is Chief Engineer and General Manager. J. C. Higgins is Master Mechanic. The company's main offices are at 508 California street, San Francisco, Cal. (Official.)

Oregon Short Line.—Under the title of the Wyoming Western (Sept. 28, p. 644) the company is building a line from a point about three miles west of Kemmerer, Wyo., south 16½ miles to Muddy Gap. The Utah Construction Co., of Ogden, Utah, has the contract. About 10 per cent. of the grading is completed. About 500 men and 400 teams are at work. The maximum grade is 1 per cent., and the maximum curve 4 deg. The rails for laying are on hand. The company will also build a spur 2⅓ miles long to a coal mine six miles south of the northern terminus of the main line. This new branch opens up coal fields and the business will be largely coal. Beyond Muddy Gap the route has not been decided upon. (Official.)

Pella & Southwestern.—A Wabash officer denies that his company is interested in this proposed line. (Sept. 28, p. 644.)

Pemiscot Southern.—This company has been incorporated in Missouri, with a capital stock of $200,000, to build a line from Pascola, Pemiscot County, south 20 miles to a point on the Arkansas state line. L. B. Houck, of Cape Girardeau, President of Houck's Missouri & Arkansas, is an incorporator.

Rio Grande Western.—The improvements under way near Soldier Summit, Utah (Sept. 21, p. 628), are simply the widening out of one small cut as a protection against snow. (Official.)

Savannah Wharf & Terminal.—Application has been made in Georgia to incorporate this company, with a capital stock of $20,000, which may be increased to $200,000, to build a terminal line in Savannah, connecting the Central of Georgia with the Savannah, Florida & Western line of the Plant System. This seems to be a different project from that of the Savannah Union Station Co. (Oct. 5, p. 662.) The incorporators of the S. W. & T. are: William W. Gordon, Beirne Gordon, W. W. Gordon, Jr., J. H. Kinzil, W. G. Harrison, R. C. Harrison, B. Hunter, Thomas Hunter, H. M. Peek, W. Q. Hughes, and Jos. A. Logan, all of Savannah.

Southern Pacific.—Surveys are reported in progress for a branch from the main line, either at San Miguel or Bradley, Cal., to the Slacks Canyon coal mines.

Washington Roads.—The Phoenix Logging Co., of Hoodsport, has permanently located seven miles, and made preliminary location for 15 miles of railroad. Contracts for grading, etc., are to be let this month for the seven miles located. This is to be standard gage with 60-lb. rails. Inquiries are being made by the Manager for rolling stock. The officers of the company are: President, S. G. Simpson, Seattle, Wash.; Manager, A. H. Anderson, Seattle; Chief Engineer, H. Tilly Browne, C. E., Hoodsport, Wash. (Sept. 21, p. 628.)

Winfield.—This company has been incorporated in Pennsylvania, with a capital stock of $10,000, to build a railroad from West Winfield to Dennis Mills, Butler County. The incorporators are: Fred. W. McKee (President), Melissa P. McKee, Mary Sullivan, A. W. Duff, W. P. Greer and E. L. Devore, all of Pittsburgh; P. B. G. Bealor, of Aspinwall, and Simon B. Smith, of Allegheny.

Wisconsin Central.—The Chief Engineer writes that no work is authorized on Boom Island, Minneapolis, at present. (Sept. 28, p. 644.)

GENERAL RAILROAD NEWS.

Atlantic Coast Line Company of Connecticut.—At the annual meeting, on Oct. 3, the directors were authorized to distribute $10,000,000 4 per cent. certificates of indebtedness among the present holders of the company's stock as a 100 per cent. dividend to represent the profits of the company from the consolidation by which the Atlantic Coast Line R. R. Co. was formed. Final action will be taken by the stockholders on Oct. 16. (May 4, p. 296.)

Chicago & Grand Trunk.—The date of foreclosure sale has been fixed for Oct. 31, at Port Huron, Mich. (Sept. 21, p. 628.)

Chicago, Burlington & Quincy.—Holders of Iowa Division bonds are notified that $233,734.29 has been set aside to purchase these bonds at 105 and accrued interest, and that bids will be received up to Oct. 25 at the Assistant Treasurer's office in Boston.

Chicago, Greenville & Southern.—The Metropolitan Trust Co., as trustee, has brought suit to foreclose the mortgage of 1892, to secure $55,000 of bonds. (Aug. 31, p. 588.)

Cincinnati, Richmond & Muncie.—C. E. Loss & Co., of Chicago, who contracted to build this electric line from Richmond, Ind., to Muncie, 60 miles, and who have completed considerable work on their contract, have applied for a receiver for the property on the ground that the railroad company has refused to make accounting of the work in accordance with the contract. (Construction Supplement, July 27, 1900.)

Gulf & Interstate.—H. S. Spangler, at Galveston, Tex., has taken charge of this property as receiver. The line is about 70 miles long, and some 27 miles was destroyed in the recent storm. (July 27, p. 518.)

Kansas City & Omaha.—The annual report of the Chicago, Burlington & Quincy confirms the statement of the purchase of the control of this company's securities by the Burlington. It was not completed until near the close of the fiscal year and the earnings and expenditures on the 193 miles are not included in the last report. (July 27, p. 518.)

New Orleans & Western.—No sale was made of this property at the auction at Port Chalmette, La., Oct. 6. A number of objections were filed and the matter has been referred back to the courts for decision. (Sept. 7, p. 692.)

Pittsburgh, Cincinnati, Chicago & St. Louis.—Jeffersonville, Madison & Indianapolis bonds of 1866, for $225,000, have been drawn for payment at 110 and interest, at the Farmers' Loan & Trust Co., interest to cease in 30 days from Oct. 3.

Pittsburgh & Western.—The $81,000 first mortgage 6 per cent. bonds of the old company, due Oct. 15, will be paid at maturity at the First National Bank, Allegheny, Pa. (Aug. 31, p. 588.)

St. Louis Southwestern.—The company last week declared 2 per cent. semi-annual interest on its second 4 per cent. income bonds, payable Jan. 2, 1901. The full 4 per cent. was paid during the last fiscal year. (Nov. 3, 1899, p. 770.)

Santa Fe & Grand Canyon.—The Atchison, Topeka & Santa Fe has arrangements with E. D. Gage, of Prescott, receiver of this property, to operate the railroad for the present. The line runs from Williams, Ariz., on the Atchison, north about 54 miles toward the Grand Canyon of the Colorado. (Sept. 14, p. 614.)

Seaboard Air Line.—The net earnings of the system, including the Bay Line, a total of 2,358 miles, for the fiscal year ended June 30, are reported at $2,634,061. The fixed charges are $1,463,500, leaving a balance of $1,170,561. It is stated that this balance is $300,000 more than the total interest and rentals required after the consolidation. The $1,100,000 car trusts outstanding in September are being paid off by monthly installments from current earnings and are not included under the above fixed charges. For the current year it is estimated that the road should earn $11,610,000 gross, and $3,870,000 net. After deducting $2,337,000 charges and rentals this would leave a surplus of $1,533,000, enough to retire one-third of the car trust obligations and pay 4 per cent. on the preferred stock. Of the 20 roads which make up the combined system, the parent company controls 100 per cent. of the capital stock of 13 companies, between 99 and 100 per cent. of four more, between 90 and 100 per cent. of the Florida Central & Peninsular, and nearly all of the Georgia & Alabama. (Oct. 5, p. 662.)

Union Pacific.—A payment of $133,900 on the Kansas Division has been made to the United States Government. (Nov. 3, 1899, p. 770.)